Notice No.1

Rules and Regulations for the Classification of Offshore Units July 2019

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Please note that corrigenda amends to paragraphs, Tables and Figures are not shown in their entirety.

Issue date: November 2019

Amendments to	**Effective date**	**IACS/IMO implementation (if applicable)**
Part 3, Chapter 1, Sections 3, 4 & 7	1 January 2020	N/A
Part 3, Chapter 3, Section 2	1 January 2020	N/A
Part 3, Chapter 8, Sections 1 & 3	1 January 2020	N/A
Part 3, Chapter 10, Sections 1 & 16	1 January 2020	N/A
Part 3, Chapter 11, Section 1	1 January 2020	N/A
Part 7, Chapter 2, Section 8	1 January 2020	N/A
Part 7, Chapter 3, Section 3	1 January 2020	1 January 2020
Part 10, Chapter 1, Section 5	1 January 2020	N/A
Part 10, Chapter 2, Sections 3, 4, 7 & 8	1 January 2020	N/A
Part 10, Chapter 3, Section 1	1 January 2020	N/A
Part 10, Chapter 4, Section 1	1 January 2020	N/A
Part 11, Chapter 1, Section 1	1 January 2020	N/A
Part 11, Chapter 4, Sections 2, 3, 4 & 6	1 January 2020	N/A
Part 12, Chapter 1, Sections 1, 3, 4, 8, 9, 11, 12, 13, 14 - 40	1 January 2020	N/A

Lloyd's Register

Part 3, Chapter 1
General Requirements for Offshore Units

■ *Section 3*
Operations manual

3.2 Information to be included

(Part only shown)
3.2.1 In general, the Operations Manual should include the following minimum information, as applicable:

- Identification of the helicopter used for the design of the helicopter deck.
- Access manual and/or drawings showing access arrangement and access openings.

■ *Section 4*
Materials

4.4 Minimum design temperature

4.4.2 The minimum design air and sea temperatures for exposed structure are to be taken as the lowest daily average temperature for the unit’s proposed area of operation, based on a return period of occurrence of:
(a) 50 years for Mobile Offshore Units.
(b) 100 years for Floating Offshore Installations at a fixed location.
Where
Daily average temperature = the average temperature during one day and night.
The temperature is to be rounded down to the nearest degree Celsius. Consideration is to be given to the minimum temperature ~~at the ship yard during construction and testing, and~~ along transit routes for any voyage of the unit from one geographical location to another.

■ *Section 7*
Permanent means of access

7.1 General

7.1.1 Offshore units should be designed and built with due consideration as to how they will be surveyed during their in-service life and how it will be possible to monitor the condition of the unit. ~~Each space within the unit should be provided with at least one permanent means of access to enable, throughout the life of a unit, overall and close-up inspections and thickness measurements of the unit’s structures to be carried out by LR, the company, and the unit’s personnel and others, as necessary.~~ Arrangements for permanent means of access, in accordance with SOLAS Regulation II-1/3-6, are applicable where required by the National Authority.

7.1.2 Means of access ~~should~~ may comply with the applicable provisions of *2009 MODU Code - Code for the Construction and Equipment of Mobile Offshore Drilling Units, 2009 – Resolution A.1023(26)*, paragraph 2.2 and with the Technical provisions for means of access for inspections, adopted by the Maritime Safety Committee by *Resolution MSC.133(76) - Adoption of Technical Provisions for Means of Access for Inspections - (adopted on 12 December 2002)*, subject to amendment by the IMO. *See also IACS Unified Interpretations for the application of MODU Code Chapter 2 paragraphs 2.1, 2.2, 2.3, 2.4 and revised technical provisions for means of access for inspections (resolution MSC.158(78))*.

7.1.7 The access manual and/or drawings showing the access arrangements and access openings to tanks, cofferdams and other spaces within the unit should be included in the Operations Manual.

Part 3, Chapter 3
Production and Storage Units

■ *Section 2*
Structure

2.12 Access to spaces in oil storage areas

2.12.7 Where the tanks are of confined or cellular construction, and have a length of 35 metres or more, two separate means of access from the weather deck are to be provided, one to be provided at either end of the space. Tanks less than 35 metres in length shall be served by at least one access hatchway and ladder. When a tank is subdivided by one or more swash bulkheads or similar obstructions which do not allow ready means of access to the other parts of the tank, at least two hatchways and ladders shall be fitted. All tanks are to be provided with clear access for inspection without any obstruction by permanent and temporary provisions arrangement for ventilation or others.

Part 3, Chapter 8
Process Plant Facility

■ *Section 1* General

1.1 Application

1.1.1 The requirements of this Chapter apply to the process plant facility on board production and storage units as defined in *Pt 3, Ch 3 Production and Storage Units*. The process plant facility includes the equipment and supporting structure and systems used for oil and gas production including inlet facilities, separation, treating and processing systems and equipment and systems used in support of production operations, where permitted by the national Flag Administration. The requirements of this Chapter are considered to be supplementary to the requirements in ~~the~~ other relevant Parts of the Rules.

1.1.2 The Rules cover the design strength and safety aspects of the process plant facility installed on board production and storage units, and the aim to minimise the risk to personnel on board and facilities.

1.1.3 The operational aspects, performance and reliability of the ~~production and~~ process plant facility are not covered by class except when they have an effect on the overall safety of the production unit, the personnel on board or the environment.

1.1.4 The Rules are framed on the understanding that a unit with an installed ~~production and~~ process plant facility will not be operated in environmental conditions more severe than those for the design basis and class approval.

1.1.5 It is the responsibility of the Owners/Operators to ensure that the ~~production and~~ process plant facility is properly maintained and operated by qualified personnel and that the test and operational procedures are clearly defined and complied with.

1.2 Class notations

1.2.2 Production units with an installed process plant facility which comply with the requirements of this Chapter, or recognised Codes and Standards and its complementary requirements previously agreed with LR (*see Pt 3, Ch 8, 1.5 Recognised Codes and Standards*), will be eligible for the assignment of the special features class notation **PPF**.

1.3 Scope

(Part only shown)
1.3.1 The following additional topics applicable to the special features class notation are covered by this Chapter:

- Major equipment and structures of the ~~production and~~ process plant facility, such as, but not limited to~~.~~:
  - Oil or gas production, processing and treating system, including flowlines from the riser termination flanges at the turret or agreed interface, manifolds, production swivels, separators, heaters and coolers, processing columns, piping systems, relief and blowdown systems and produced water treatment systems.
  - Production plant utility systems when they have an effect on the overall safety of the production unit and the personnel on board.

1.3.2 Unless agreed otherwise with LR, the ~~Rules~~ *Rules and Regulations for the Classification of Offshore Units, July 2019* consider the following as the main boundaries of the ~~production and~~ process plant facility:

- Any part of the production and process system located on the unit including the riser connecter valve or christmas tree but excluding the risers is considered part of the ~~facility~~ process plant.
- The shut~~-~~down valve at the ~~export~~ outlet from the production or process plant to the storage or offloading facility.
- The outlet from hydrocarbon flare and vent systems.
- Interfaces between marine and process plant utilities systems when shared across the production unit *(see Pt 3, Ch 8, 1.3 Scope 1.3.4* and *Pt 3, Ch 8, 3.2 General requirements for process and utilities piping systems 3.2.3* for further guidance).

1.3.3 Marine piping systems, hull machinery piping systems, bulk storage and offloading of process plant products such as oil and gas condensates and crude oil and bulk storage, loading and offloading of chemicals required for the operation of the process plant are to comply with the *Rules and Regulations for the Classification of Ships, July 2019* and applicable IMO International Conventions and Codes such as SOLAS and the IBC Code; these systems are to be considered classed (CL).

1.3.4 Boundaries on the production and utilities systems of the process plant facility which are covered by this part of the Rules (*see Pt 3, Ch 8, 1.3 Scope 1.3.3*) and those covered by the *Rules and Regulations for the classification of Ships* are to be defined and agreed with LR at the earliest stages of the project through the mark-up of Process and Utilities Flow Diagrams (PFDs and UFDs) and, subsequently confirmed at a mature stage of the project, through the mark-up of the Piping and Instrumentation Diagrams (P&IDs). Those diagrams are to show the interfaces between the process plant systems covered under these Rules and the classed systems as referenced *in Pt 3, Ch 8, 1.3 Scope 1.3.3.*

1.4 Plant design characteristics

1.4.3 The process plant facility as detailed in *Pt 3, Ch 8, 1.3 Scope* and any supporting structures above the deck are to be designed for all operating and transit conditions in accordance with recognised and agreed Codes or Standards, suitably modified to take into account the unit's motions and marine environmental aspects. Except for the emergency condition, as detailed in *Pt 3, Ch 8, 1.4 Plant design characteristics 1.4.4*, the total stress in any component of the plant is not to exceed the applicable Code value at the temperature concerned, unless expressly agreed otherwise by LR, whether the plant is operative or non-operative, when subjected to any possible combination of the following loads, as applicable:
(a) Static and dynamic loads due to wave-induced motions of the unit.
(b) Loads resulting from hull flexural effects at the plant support points, as appropriate.
(c) Direct wind loads.
(d) Normal gravity and functional loads.
(e) Thermal loads, as appropriate.
(f) Ice and snow loads, as appropriate.

1.4.4 In general, the process plant facility and its equipment as detailed in *Pt 3, Ch 8, 1.3 Scope* and any supporting structures above the deck are to be designed for an emergency static condition with the unit inclined to the following angle:

- Column-stabilised and tension-leg units:
  25° in any direction.
- Surface type units:
  22,5° heel, port and starboard, and trimmed to an angle of 10° beyond the maximum normal operating trim.
- Self-elevating units:
  17° in any direction in transit conditions only.

These angles may be modified by LR in particular cases as considered necessary. In no case is the inclined angle for the emergency static condition to be taken less than the maximum calculated angle in the worst damage condition in accordance with the appropriate damage stability criteria.

1.4.5 In the emergency condition defined in *Pt 3, Ch 8, 1.4 Plant design characteristics 1.4.4*, the plant is to be assumed to have maximum operating weights, temperatures and pressures unless agreed otherwise with LR. Systems or equipment that could be shut down and depressurised in advance of this event may not need to be designed to satisfy this requirement. For such systems or equipment, a risk assessment (*see* ISO 31010: Risk management, Risk assessment techniques) is to be presented to LR in which the credible events that can lead to the damage condition are identified, followed by those systems or equipment that could be shut down and if required depressurised, demonstrating that neither the integrity of the process plant nor the safety of the personnel on board is impaired. When applicable, the plant is also to be subjected to ice and snow loads. Wind loads need not be considered to be acting during this emergency condition. The total stress in any component of the plant or support structure above the deck is not to exceed the minimum yield stress of the material.

1.5 Recognised Codes and Standards

1.5.1 ~~Installed process plant facility~~ Process plant facilities designed and constructed to international Codes and ~~standards~~ Standards other than the Rule requirements will be considered for classification, subject to the alternative standards being agreed by LR to give an equivalent level of safety to the Rule requirements. It is essential that in such cases LR is informed of the Owner's proposals at an early stage in order that a basis for acceptance of the standards ~~may be~~ is agreed with LR. *See* ~~*Pt 12, Ch. 1, 9 Concrete structures*~~ *Pt 12 Recognised Codes and Standards for the Classification of Offshore Units* for applicable international Codes and Standards considered by LR as an equivalent level of safety to Rule requirements.

1.5.2 In general, the requirements in this Chapter are based on internationally recognised Codes and Standards for the ~~production and~~ process plant facility as defined in ~~Appendix A~~*Pt 12 Recognised Codes and Standards for the Classification of Offshore Units*. Other Codes and National Standards may be used after special consideration and prior agreement with LR. When considered necessary, additional Rule requirements are also stated in this Chapter.

1.5.3 Where necessary, the requirements of those agreed Codes and standards are to be suitably modified and/or adapted to take into account all marine environmental aspects.

1.5.5 The mixing of Codes or ~~S~~standards for each equipment item or system is to be avoided. Deviation from the Code or ~~S~~standard or the intentional mixing of them must be specially noted in the documentation and approved by LR.

1.6 Equipment categories

1.6.1 The approval and certification of ~~production and~~ process plant equipment in accordance with this Chapter are to be based on equipment categories previously agreed with LR.

1.6.2 Production and process plant equipment including its associated pipes ~~and~~, valves, instrumentation, electrical installations and skids is to be divided into equipment Categories **1A**, **1B** and **II**, depending on the complexity of manufacture and its importance with regard to the safety of personnel and the installation and the possible effect on the environment.

1.6.3 The following equipment categories are used in the Rules:
1A Equipment of primary importance to safety, for which design ~~verification~~ appraisal and survey during fabrication are considered essential. Equipment in this category is of complicated design/manufacture and is not normally mass produced.
1B Equipment of primary importance to safety for which design ~~verification~~ appraisal and witnessing the product quality are considered essential. Equipment in this category ~~is normally~~ may or may not be mass produced ~~and~~ but not included either in category **1A** or **II**.
II Equipment related to safety which is normally mass produced and manufactured to recognised Codes and Standards and it has proven reliability in service but excludes equipment in category **1A** and **1B**.

1.6.4 Equipment, piping and fittings for storage, offloading and marine systems inclusive of those that will be shared with the process plant systems are to comply with the *Rules and Regulations for the Classification of Ships, July 2019* and are to be built under survey in compliance with *Pt 5, Ch 1, 1 General* and categorised as ‘classed’ for the purpose of equipment categorisation under this Rule.

~~1.6.4~~ 1.6.5 A guide to equipment and categories is given in *Pt 3, Ch 21 Guidelines on Scope of Survey Certification of Safety Critical Equipment.* A full list of equipment categories for each ~~production and~~ process plant facility is to be agreed with LR before its design and manufacture. Minor equipment components and systems or equipment that, through the use of a risk assessment and/or in agreement with LR are demonstrated as not impairing the safety of the production unit, need not be categorised. For process plant equipment not listed in the above-referenced Chapter, designers and manufacturers should contact the LR Technical Support Office for further guidance on design and survey requirements that will be applicable to that particular equipment.

1.7 Equipment certification

1.7.1 Equipment is to be certified in accordance with the following requirements:

(a) **Category 1A**

- Design verification ~~and issue of certificate of design strength approval~~ and issue of a Design Appraisal Document (DAD) as applicable to the equipment in question, any exception to this Rule requirement requires prior agreement with LR.
- Pre-inspection meeting at the suppliers with agreement and marking of quality plan and inspection schedule.
- Survey during fabrication ~~and review of fabrication documentation~~.
- Review of fabrication documentation (Manufacturer Record Book).
- Final inspection with monitoring of function/pressure/load tests ~~and issue of a certificate of conformity,~~.
- Issue of a certificate of conformity.

(b) **Category 1B**

- Design verification and issue of a DAD as applicable to the equipment in question, to be defined on a case-by-case basis at the equipment categorisation stage *(see Pt 3, Ch 8, 1.6 Equipment categories 1.6.5)*.
- ~~Design verification and issue of certificate of design strength approval, where applicable, and review of fabrication documentation.~~
- Final inspection with monitoring of function/pressure/load tests ~~and issue of certificate of conformity~~.
- Review of fabrication documentation (Manufacturer Record Book).
- Issue of a certificate of conformity.

(c) **Category II**

- Supplier’s/manufacturer’s works’ certificate giving equipment data, limitations with regard to the use of the equipment and the supplier’s/manufacturer’s declaration that the equipment is designed and fabricated in accordance with the project recognised Standards or Codes and any specific project requirements.

1.7.2 All equipment recognised as being of importance for the safety of personnel and the production and process plant facility is to be documented by a ~~data book~~ Manufacturer Record Book.

1.7.3 A guide to equipment survey is given in *Pt 3, Ch 21 Guidelines on Scope of Survey Certification of Safety Critical Equipment.*

1.8 Fabrication records

(Part only shown)

1.8.1 Fabrication records are to be made available for Categories **1A** and **1B** equipment for inspection and acceptance by LR Surveyors. These records should include the following:

- Traceability of materials and materials certificates (*see Pt 3, Ch 8, 4.4 Materials* for further details).

1.9 Installation of plant equipment

(Part only shown)

1.9.1 The installation of equipment on board the unit is to be controlled by LR in accordance with the following principles:

- All Category **1A** and **1B** equipment delivered to the unit is to be accompanied by a certificate of design ~~strength approval and~~ appraisal (DAD) as applicable to the equipment in question, an equipment certificate of conformity and all other necessary documentation.
- Control and follow-up of non-conformities/deviations/conditions or limitations specified in design certificates and certificate of conformity.

1.11 Plans and data submissions

1.11.1 Plans, calculations and data are to be submitted as required by the relevant Parts of the Rules together with the additional plans and information listed in this Chapter. Plans are to be submitted in ~~triplicate, but only a single copy of supporting documents and calculations is required~~ electronic format, although hard copies will also be accepted.

■ *Section 3*
Production, process and utility systems

3.1 Plans and particulars

3.1.1 ~~Plans~~ The plans and particulars ~~showing arrangement~~ listed below of production, process and utility systems and equipment ~~listed in~~ (*see Pt 3, Ch. 8, 1.3 Scope*), and ~~diagrammatic plans of the~~ their associated piping systems, are to be submitted for approval.

- Basis of design;
- Project philosophies such as emergency shutdown (ESD), relief and blowdown, isolation, hazardous areas, layout and piping, stress analysis, etc.;
- Equipment layouts or plot plans, piping arrangements;
- Piping and Instrument Diagrams (P&IDs), Process Flow Diagrams (PFDs);
- Risk studies or reports such as fire and explosion, HAZOP, HAZID, QRA, LOPA, SIL determination and SIL Validation cold spill, firewater demand, etc.;
- Process calculations or reports such as line sizing for overpressure protection devices, flare KO drums, surge on offloading systems, surge on hot oil and cooling water systems, etc.;
- Overpressure and underpressure protection devices calculations or reports and datasheets;
- Relief, blowdown and flare calculations or reports;
- Flare calculations inclusive of radiation, dispersion of combustion gases and flame out condition;
- Cold vent calculations inclusive of dispersion of vented gases and radiation due to unexpected ignition;
- Flow induced (FIV) and acoustic induced vibration (AIV) assessment;
- Piping and valves materials specifications and datasheets;
- Equipment specification and datasheets;
- Line lists and critical line lists;
- Cause and effects matrix;
- Control schematics;
- Piping stress analysis;
- Classification of hazardous area schedule and drawings.

The list above is not exhaustive. LR reserves the right to request any additional documents considered necessary for design appraisal.

This Section also applies to marine and machinery systems and storage and offloading systems that have a direct interaction or that are shared with the process plant.

3.2 General requirements for process and utilities piping systems

3.2.1 The design and construction of the piping systems, piping and fittings forming parts of such systems are to be in accordance with a recognised Code or Standard, *see Pt 3, Ch 8, 1.5 Recognised Codes and Standards*, and if the Owner has decided to class the process plant facility in full compliance with *Pt 3, Ch 8 Process Plant Facility*, are also to comply in full with the remainder of this Section.

3.2.2 Piping systems for the ~~production and~~ process plant facility are, in general, to be separate and distinct from piping systems essential to the safety of the production unit. Notwithstanding this requirement, this does not exclude the use of the production unit's main, auxiliary and/or essential services for process plant operations in suitable cases. Attention is drawn to the relevant Chapters of *Pt 5 Main and Auxiliary Machinery*, ~~Main and Auxiliary Machinery,~~ when such services are to be utilised. Substances which are known to present a hazard due to a reaction when mixed are to be kept entirely separate.

3.2.3 In cases where marine, storage, loading and offloading systems are integrated with the process plant facility systems, i.e. instrument air, nitrogen, cooling water, cargo, etc., there shall be an interface isolation valve preferably located at the topsides in an accessible location. This valve shall allow the isolation of the process plant section in cases in which the process plant may impair the safety and integrity of the marine system and consequently the overall safety of the production unit. Where it can be demonstrated through the use of a risk assessment (*see* ISO 31010: *Risk management, Risk assessment techniques*) that the safety and integrity of the marine system is not compromised, this valve will not be required.

3.2.4 The valve referenced in *Pt 3, Ch 8, 3.2 General requirements for piping systems 3.2.3* will also act as the break point between the process plant facility systems under *Rules and Regulations for the Classification of Offshore Units, July 2019* (*see Pt 3, Ch 8, 1.3 Scope 1.3.3* and *Pt 3, Ch 8, 1.3 Scope 1.3.4*) and class system under *Rules and Regulations for the Classification of Ships, July 2019.*

~~3.2.3~~ 3.2.5 All piping systems are to be suitable for the service intended and for the maximum pressures and temperatures to which they are likely to be subjected inclusive of transient conditions such as surge, depressurisation and relief when applicable.

~~3.2.4~~ 3.2.6 The number of detachable pipe connections in hydrocarbon production and process piping is to be ~~limited~~ minimised to those which are necessary for installation and ~~dismantling~~ maintenance. The pipe connections are to be suitable for the intended use.

Existing paragraph 3.2.5 has been renumbered 3.2.7.

~~3.2.6~~ 3.2.8 The production and process system piping is to be protected from the effects of fire, mechanical damage~~,~~ and other factors such as erosion and corrosion, vibration, hydraulic hammering and pressure surges. Corrosion coupons or test spool pieces are to be designed into the system. Spool pieces are to be fitted in such a manner as to be easily removed or replaced. Sand probes and filters should be provided where necessary for extraction of sand or reservoir fracture particles.

~~3.2.7~~ 3.2.9 The corrosion allowance for hydrocarbon production and process piping of carbon steel is not to be less than 2 mm unless a corrosion assessment appropriate to the expected operating/design conditions of the process plant systems demonstrate allowance could be reduced.

Existing paragraph 3.2.8 has been renumbered 3.2.10.

3.2.11 The process plant, inclusive of process and utility systems that can contain flammable or toxic fluids, shall be divided into isolatable sections through the use of shutdown valves that are operated from the ESD system. The criteria to determine the extent of an isolatable section shall as a minimum be based on the characteristic of the plant layout, volume of inventory, operating conditions, fire zones and depressurisation zones.

~~3.2.9~~ 3.2.12 Arrangements are to be made to isolate the unit from the supply and discharge of produced oil and gas by the provision of suitable shut-down valves on the unit and at the receiving installation. The valves on board the unit ~~are to~~ shall be ~~operable~~ operated from the control stations as well as locally at the valve.

~~3.2.10~~ 3.2.13 If a single failure in the supply from utility systems such as compressed air or cooling water which are essential to the operation of the ~~production and~~ process plant facility could cause an unacceptable operating condition to arise, an alternative source of supply is to be provided unless it is demonstrated that the unit could be safely shut down.

Existing paragraph 3.2.11 has been renumbered 3.2.14.

~~3.2.12~~ 3.2.15 The locking open/closed of valves is to be by means of a suitable keyed locking device or a similar system operated under a permit-to-work system.

~~3.2.13~~ 3.2.16 For process vessels which periodically require isolation prior to gas-freeing and personnel entry, pipelines which connect the vessel to a source of pressure and/or hazardous fluid are to be provided with isolating valves, bleed arrangements and means to blank off the open end of the pipe. For systems containing significant hazards, consideration is to be given to double block and bleed valves and blanking-off arrangements (*see Pt 3, Ch 8, 3.2 General requirements for piping systems 3.2.17* for further guidance).

3.2.17 Arrangements appropriate for the safe isolation of the process plant and its equipment shall be provided for those process and utility systems containing high pressure, toxic or flammable fluids that require to be opened for maintenance or any other intervention while other connected sections of the process plant remain in operation or pressurised. Reference for guidance is made to UK HSE Safe Isolation of Plant and Equipment together with any other particular requirements that are referenced within these Rules.

~~3.2.14~~ 3.2.18 For ship units and other surface type units, the design of piping systems should take into consideration the effect of hull girder bending in addition to any relative movement between modules.

3.2.19 A complete stress analysis is required for those process and utility systems determined as critical for the safety and integrity of the production unit; it should be performed in accordance to ASME B31.3. The analysis is to consider factors such as acceleration loads, pressure surge, reaction forces induced by PSVs, blast, extreme environmental conditions, hull bending and inclination of the production unit as per the damaged condition (*see Pt 3, Ch 8, 1.4 Pant design characteristics 1.4.4*).

3.2.20 Evaluation of piping systems required to maintain their integrity in an explosion event shall be performed. Normal operating conditions should be considered, including the blast drag load. The maximum allowable stress in the blast case shall be the minimum of $2{,}4S_h$ or $1{,}5S_Y$, where S_h is the ASME B 31.3 hot allowable stress limit (at design temperature) and S_Y is the pipe material yield stress (at design temperature). The potential deformation of module structures and decks, including the movement of the equipment and pipe supports, shall be considered in the load case. However, for the primary load case (which in general would be gravitational load, functional load, environmental load and pressure load) inclusive of blast load, the stress level shall be limited to $1{,}8S_h$.

3.2.21 Flange leakage check shall be carried out against operating load inclusive of blast load, with the allowable stress of bolts not to exceed more than the yield stress at design temperature.

3.2.22 Small bore piping shall be appropriately supported to prevent fatigue failure due to FIV and AIV. An assessment is to be performed in accordance with a recognised methodology (*see* Energy Institute Guidelines for the Avoidance of Vibration Induced Fatigue Failure in Process Pipework).

3.4 Christmas tree

3.4.1 The christmas tree shall be designed for the maximum shut-in wellhead pressure that the reservoir can develop. The appropriate design conditions shall be in line with the predicted reservoir conditions inclusive of an appropriate safety margin.

Existing paragraphs 3.4.1 to 3.4.5 have been renumbered 3.4.2 to 3.4.6.

3.5 ~~Protective pressure relief~~ Overpressure and underpressure protection

3.5.1 Process and utilities vessels, equipment and piping (inclusive of HP/LP interfaces) and cargo storage tanks integral to the hull are to be provided with pressure-relieving devices to protect against system pressures exceeding their maximum allowable pressure such that the system will remain safe under all foreseeable conditions, unless the system is designed to withstand the maximum pressure which can be exerted on it under any circumstances. Where appropriate, sections of the production, ~~and~~ process and utilities systems and storage and offloading are to be protected against underpressure ~~resulting from a change of temperature or state of the contents,~~ *~~see also Pt 3, Ch 8, 4.9 Protective and pressure relief devices~~* which may result due to credible scenarios leading to this condition.

3.5.2 The pressure-relieving devices are to be sized to handle the expected maximum relieving rates due to any single failure or fire incident; potential overpressure scenarios are to be properly described, documented and governing scenarios selected, an appropriate review of the different operational modes inclusive of start-up and maintenance should be assessed to identify any potential scenario capable of overpressurise the system or equipment. A similar assessment requires to be performed for the underpressure case. The rated discharge capacity of any pressure-relieving device is to take into account the maximum back pressure that could be developed in the vent or relief system due to simultaneous releases that may be present.

3.5.3 Overpressure and underpressure protection design for cargo tanks of the production unit which is in compliance with IMO conventions and codes shall consider any other scenario imposed into them by the process plant facility; those scenarios require to be properly considered and, when not covered by any of the IMO conventions and codes, they require to be in compliance with API Std 2000 or any other suitable code/standard. Fire case on the deck and sides of those tanks shall be considered.

~~3.5.3~~ 3.5.4 For protected items or sections of the system not in continuous service, a single pressure-relieving device is acceptable. Block valves for maintenance purposes, where fitted, in the pressure relief lines are to be interlocked with the source of pressure or spare relief valves as applicable to ensure that a relief path is always available.

~~3.5.4~~ 3.5.5 For any particular item or section of the system in continuous service at least two pressure relief ~~possibilities~~ devices are to be provided for operational and maintenance purposes. In this case, each pressure relief ~~possibility~~ device is to be designed to handle 100 per cent of the maximum relieving rate expected unless alternative systems are available or short-term shutdown is acceptable. Where the equipment has redundancy and can be properly isolated without compromising the safety of the facility or the personnel, a single pressure relief device is acceptable.

~~3.5.5~~ 3.5.6 If more than two pressure relief ~~possibilities~~ devices are provided on any particular item or section of the system in continuous service, and any pressure relief ~~possibility~~ device is designed to handle less than 100 per cent of the maximum relieving rate expected, the arrangements are to be such as to allow any one device to be isolated for operational and maintenance purposes without reducing the capacity of the remaining devices below 100 per cent of the maximum relieving rate.

~~3.5.6~~ 3.5.7 Block valves fitted in pressure relief lines for isolation purposes are to be of the full-~~flow~~ bore type, capable of being locked in the fully open position ~~by an approved keyed method~~. Where isolating valves are arranged downstream and upstream of a relief device, they are to be interlocked with each other in order to ensure 100 per cent capacity of the maximum required relieving rate.

~~3.5.7~~ 3.5.8 The arrangement in *Pt 3, Ch 8, 3.5 ~~Protective pressure relief~~ Overpressure and underpressure protection 3.5.~~4~~5* or *Pt 3, Ch 8, 3.5 ~~Protective pressure relief~~ Overpressure and underpressure protection 3.5.~~5~~6* is to ensure that all relief possibilities cannot be isolated from the system at the same time, by interlocking the block valves using an approved keyed method of interlocking or a similar system operated under a permit-to-work system.

~~3.5.8~~ 3.5.9 The set pressure for all pressure-relieving devices should generally not exceed the design pressure of the weakest component on the protected system or ~~item~~ equipment. Pressure relief valves are to be sized such that any accumulation of pressure from any source will not exceed 110 per cent of the design pressure; exception to this Rule is a fire case in which the accumulated pressure will not exceed 121 per cent of the design pressure.

~~3.5.9~~ 3.5.10 Bursting discs fitted in place of, or in series with, a pressure relief valve are to be rated to rupture at a pressure not exceeding the design pressure of the protected system or ~~item~~ equipment at the operating temperature. However, in the case of a bursting disc fitted in parallel with a relief valve(s), such as in vessels containing substances which may render a pressure relief valve inoperative or where rapid rates of pressure rise may be encountered, the bursting disc is to be rated to burst at a maximum pressure not exceeding ~~1,3 times the design pressure of the vessel~~ the maximum accumulated pressure as identified in *Pt 3, Ch 8, 3.5 Overpressure and underpressure protection 3.5.9* at the operating temperature.

3.5.11 Bursting discs are only to be used for pressure vessels located in open areas or if fitted in conjunction with a relief line led to an open area. Where a bursting disc is fitted downstream of a safety valve, the maximum bursting pressure is also to be compatible with the pressure rating of the discharge system. Bursting discs are to be non-fragmenting type.

Existing paragraph 3.5.10 has been renumbered 3.5.12.

~~3.5.11~~ 3.5.13 In circumstances where hazardous vapours (toxic or flammable) are released directly to the atmosphere, the outlets are to be arranged to vent to a safe location where personnel would not be endangered; the determination of this safe location is to be confirmed through the development of gas dispersion and unexpected ignition analysis (*see* API Std 521 Section 5.8).

Existing paragraphs 3.5.12 to 3.5.17 have been renumbered 3.5.14 to 3.5.19.

3.5.20 Where pumps or pressure surges due to the suddenly closure of valves or the shutdown of pumps are capable of developing pressures exceeding the design conditions of the system, effective means of protection such as pressure relief devices or equivalent are to be provided.

3.5.21 Pressure relief devices are to be type tested to establish their discharge capacities at their maximum rated design pressures and temperatures in accordance with an approved Code or Standard.

3.5.22 Provision of instrumented protection systems as alternatives to pressure-relieving devices could be accepted in a case-by-case basis, i.e. high integrity pressure protection systems (HIPPS); when proposed, it should follow guidelines described in standards such as API Std 521 Annex E and API RP 17O.

3.5.23 Balanced pressure relief valves in toxic service shall have the bonnet vent discharge to a safe location; it shall be demonstrated by dispersion analysis that the toxic gas levels that may be discharged from the bonnet vent or associated vent tubing are acceptable where personnel may be located.

3.6 ~~Flaring arrangements~~ Relief disposal systems

3.6.1 Facilities for gas flaring and oil burning are to be adequate for the flaring requirements during well control, well testing and production operations conducting the disposed fluids to a safe location. Scenarios for individual relief loads as well as simultaneous flare loads due to common modes of failure, during normal operation, upset conditions and emergency, are to be considered when designing and sizing the relief system and associated flare or vent.

3.6.2 For well testing, at least two flare lines are to be arranged through which any flow from the well can be directed to different sides of the unit; for turret moored or dynamic positioning units this point should be evaluated in a case by case basis.

~~3.6.2~~ 3.6.3 The flare system is to be designed to ensure a clean, continuous flame. Provision is to be made for the injection of make-up gas into the ~~vent~~ relief system to maintain steady flaring conditions. A means of cooling the flare burners when used for well testing is to be available.

Existing paragraphs 3.6.3 and 3.6.4 have been renumbered 3.6.4 and 3.6.5.

~~3.6.5~~ 3.6.6 Production and process plant ~~venting~~ relief systems are to be led to a liquid separator or knock-out drum to remove any entrained liquids which cannot be safely handled by the flare. The liquid accumulation capacity of this vessel is to be based on the sizing method described in API Std 521 for a minimum time of 20 minutes of liquids that may be disengaged from the released streams during the governing scenario for liquid release. The releases that may contribute for maximum liquid accumulation should be documented. ~~Where a~~ If liquid ~~blowdown~~ or two-phase fluids are released into the relief system ~~is provided~~, adequate provision is to be made in the design for the effects of back pressure ~~in the system~~, ~~and~~ for vapour flash-off when the pressures ~~in the blowdown system~~ are reduced and slug loading during these transient events.

Existing paragraph 3.6.6 has been renumbered 3.6.7.

3.6.8 Disposed fluids are to be properly segregated to prevent mixed potential hazardous scenarios such as hydrate formation, chemical reactions, etc., as well as reducing the use of low temperature material etc. Headers can be segregated by HP sources, LP sources, cold fluids, hot fluids, water wet fluids, etc.

3.6.9 Relief tail lines and sub-headers are to be provided with a minimum slope of 1:200 towards the main headers, whilst main headers are to be provided with a minimum slope of 1:400 towards the knock-out drum, or to a low drain point, in order to prevent liquid accumulation. Installation trim as well as roll and pitch of the production unit shall be considered on the determination of the final slope.

3.6.10 Relief lines laterals should be interconnected, preferable at 45º on top of sub-headers or main headers.

3.6.11 Main headers and sub-headers shall be continuously purged with inert gas or dry fuel gas to prevent air ingress within the system and the formation of flammable mixtures within. A backup system in case of failure of the main purge source is to be provided.

3.6.12 Relief piping systems should be sized to limit the maximum velocity to Mach 0,7 on tail pipes and depressurisation lines, and to Mach 0,6 on main headers and sub-headers. Back pressures are required to be checked and be consistent with the overall design of the relief system.

3.7 Depressurising system

3.7.1 All production and process plant in which significant volumes of hydrocarbon ~~liquids and~~ gases and liquids that will vaporise with potential for incident escalation (the volume that may lead to escalation requires to be determined and demonstrated as part of the depressurisation philosophy), ~~can~~ which could be blocked in during a fire ~~is~~are to be capable of being depressurised. The capacity of the system should be based on evaluation of:

- system response time;
- heat input from defined accident scenarios;
- material properties and material utilisation ratio;
- other protection measures, e.g.~~,~~ active and passive fire protection;
- system integrity requirements.

3.7.2 The emergency depressurising system in a fire scenario is to be designed to reduce pressures to a level and in a time suitable to prevent rupture of the pressure-containing ~~components~~ envelope as a result of the material strength reduction due to overheating. As a minimum requirement for open pool fires, the depressurising system is to be designed to ensure that the pressure is reduced to half the equipment's maximum allowable working pressure or 6,9 bar g within approximately 15 minutes; for different fire types, i.e. jet fires or enclosed pool fires, a study in which a tolerable time to rupture based in the mechanical properties of the systems shall be performed. In a leak scenario, depressurisation to ~~or 6.~~,9 bar ~~whichever is lower,~~ within approximately 15 minutes should be considered to prevent escalation.

3.7.3 The cooling effect due to throttling of large volumes of high pressure gas in the discharge piping and valves during the depressurising period is to be evaluated for appropriate material selection, inclusive of a 0,6 m minimum section upstream of the pressure reduction orifice to allow for any heat transfer due to conduction. Where temperatures below minus 29°C are expected, the piping and valve material is to have specified average Charpy V-notch impact values of 27J minimum at the calculated lowest operational temperature.

3.7.4 The ~~vent~~ relief system design should ensure that allowance has been given to the possibility of high dynamic forces at pipe bends and supports during emergency depressurisation.

3.7.5 For large production plants where the relief loads may require a large disposal relief and flare system, a sequential depressurisation may be considered. A proper assessment of escalation between plant modules/zones should be performed in order to define the blowdown zones and its sequences for isolation of hydrocarbons inventory.

3.7.6 Depressurisation should start automatically on confirmed fire and gas detection. A time delay to allow the closure of ESD valves and shutdown of the process plant should be provided, and manual initiation from the ESD system should also be provided. If sequential depressurisation is required due to the size of the production unit and restriction on the flare size, prioritisation to the zone where the fire is detected is of paramount importance to preserve the integrity of the production unit.

3.7.7 Blowdown valves shall fail to the open position; however, when sequential depressurisation is to be provided and the flare could be overloaded, an air accumulator is to be provided for each blowdown valve to prevent its opening in case of loss of the main air supply.

3.8 Cold/atmospheric vents

3.8.1 A cold/atmospheric vent is acceptable only if it is determined that the gas release will not create any danger to the production unit. Due consideration should be given to the prevailing wind to ensure that gases do not flow down around operating areas. Where cold venting is provided, the arrangement is to minimise:

- Accumulation of toxic and flammable gases.
- Ignition of vent gases from outside sources.
- Flashback upon accidental ignition of the vent gases.
- Asphyxiation in the case of non-flammable/non-toxic gases.

An analysis is to be performed in which dispersion of vented gases as well as its unexpected ignition and submitted for approval to confirm that the safety of the personal and facility are not jeopardised (*see* API Std 521 Section 5.8). An appropriate set of atmospheric conditions should be selected for it.

3.8.2 ~~In~~ Cold/atmospheric vents in which there may be continuous/intermittent venting such as cargo vents, in order to avoid continuous burning of the vent gases in the case of an accidental ignition, are to be provided with an extinguishing system using a suitable inert gas ~~is to be installed~~. The extinguishing system should be sized to extinguish the maximum flow expected from the leakage of a single source on the vent and capable of three successively discharges. The operation of this system can be either manual or automatic.

3.8.3 The dew point of the gases is to be such that they will not condense at the minimum ambient temperature. In the case of liquid condensation in the cold vent piping, a drain or liquid collection system is to be provided to prevent accumulation of liquid in the vent line and a possible rainout (*see* API Std 521 Section 5.8 for further guidance).

3.9 Flare and ~~R~~radiation levels

3.9.1 The flare and its ancillaries shall be designed to provide a safe, reliable, efficient discharge and combustion of the released hydrocarbons vapours and liquids (liquids applies for well control flares only). The location ~~and designed throughput~~, height, type and size of the flare are to take into consideration the minimum and maximum governing relief scenarios, local environmental conditions, location of accommodation spaces noise levels and the levels of thermal radiation to ensure that exposure of personnel, structure and equipment is acceptable even under unfavourable wind conditions.

3.9.2 Under normal operating circumstances and continuous flaring, the intensity of thermal radiation~~, including solar radiation,~~ in unprotected areas where personnel wearing appropriate work clothes may be continuously exposed is not to exceed 1,~~9~~58 kW/m^2 in calm conditions. Solar radiation as per the facility location is to be added. Allowance for the cooling effect of wind in unsheltered areas may be taken into consideration in determining the radiation levels.

3.9.5 An analysis in which radiation levels, dispersion of combustion gases and dispersion of vented gases in case of flame-out of the flare is to be performed and submitted for approval to confirm that the safety of the personal and facility are not jeopardised. An appropriate set of atmospheric conditions should be selected for this assessment.

3.9.6 Flares shall be provided with reliable continuous type pilots. The number of pilots should be appropriate for the type and size of the flare tip. A reliable pilot ignition system is to be provided, inclusive of a back-up bottled gas supply for flame front generators (FFGs). Power supply from emergency power is to be provided in case of high energy spark type. In general, flare and ancillaries are as a minimum to comply with API Std 537 or ISO 25457 requirements, suitably modified and/or adapted for the marine environment.

3.10 Firing arrangements for steam boilers, fired pressure vessels, heaters, etc.

3.10.1 The requirements of this Section are applicable to all types of fired equipment associated with the process plant. The equipment is to be designed, constructed, installed and tested ~~to the Surveyor's satisfaction~~ in accordance with a relevant Code or Standard and in compliance with the equipment categorisation (*see Pt 3, Ch 8, 1.6 Equipment categories*).

3.11 Drain ~~S~~systems

3.11.1 ~~Drainage systems are to be provided to collect and direct drained or escaped liquids to a location where they can be safely handled or stored. In general, equipment is to be provided with a hard-piped, closed drainage system for small quantities of produced liquids, an open system handling drainage from hazardous areas, and an open system handling drainage from non-hazardous areas. These systems are to be entirely separate and distinct.~~
Drainage systems are to be provided to collect and direct drained or escaped liquids to a location where they can be safely handled or stored. In general, the process plant facility is to be provided at least with:

- Closed drainage system to collect produced liquids from equipment and piping;
- Hazardous open drainage system to collect leaks and spillage from designated hazardous areas;
- Non-hazardous open drainage system to collect leaks and spillage from designated non-hazardous areas;
- Chemicals drainage system to collect leaks and spillage from areas in which chemicals will be handled or stored; and
- Cryogenic drainage system to collect produced cryogenic liquids from equipment and piping.

These systems are to be entirely separate and distinct in order to prevent a route for the migration of a fire, flammable liquids or vapours from one hazardous area to another, or to non-hazardous areas.

3.11.2 The hazardous drainage systems are to be kept separate and distinct from those of the main and auxiliary machinery systems or any other non-hazardous drainage. Consideration will be given to directing the process facilities hazardous drains to the facilities oil storage tanks or dirty slop tanks. The hazardous drains fluids should not be allowed to free-fall into the tank. In units equipped with an inert gas system, a U-seal of adequate height, or equivalent method, should be arranged in the piping leading to the oil storage tanks.

3.11.4 Untreated overboard discharges from the process plant facility should be prevented. National or Flag Regulations are to be complied with as applicable to the production unit.

3.11.5 Drain lines flowing by gravity are to be provided with a minimum slope of 1:100 towards the drain tank in order to prevent liquid accumulation. Installation trim as well as roll and pitch of the production unit shall be considered on the final slope.

3.11.6 Appropriate flushing connections and rod out points are to be provided for those systems subject to potential blockage due to solids or sediments, i.e. mud and/or sand, that may be present on the drained area.

3.11.7 A proper philosophy is to be developed for the collection or diversion to the sea of leaks and spills of cryogenic or any other fluid which are otherwise vapours at ambient conditions.

3.11.8 The provision of a dedicated drain system for instruments or its routing to the closed drain or open drain systems will not be practical in all cases. For such cases an appropriate philosophy should be developed for drainage where required during operation. Considerations of the fluid properties are to be accounted for. In addition, drainage from instruments is to be considered for the classification of hazardous areas.

Part 3, Chapter 10
Positional Mooring System

■ *Section 1*
General

1.2 Class notations

1.2.6 Inshore/at-shore-moored units provided with a long-term terminal mooring system, which complies with the requirements of *Pt 3, Ch 10, 16 Long-term nearshore positional mooring system* will be eligible for the assignment of a special features class notation **LTMOOR**.

■ *Section 16*
Long-term nearshore positional mooring system

16.1 General

16.1.1 The requirements of this Section shall apply to inshore/at-shore-moored units with station-keeping capabilities to remain at terminal facilities and are additional to those applicable in other Sections of the Rules. This shall cover units with permanent or semi-permanent mooring systems at terminal facilities such as floating power generation, LNG terminals with onshore regasification or a FSRU that regasifies cargo LNG and exports to a gas network onshore. Essentially, this Section does not apply to a ‘mooring system’ anchored to the sea bed.

16.1.2 The terminal mooring system is to provide restraining forces at terminal facilities in the long term, normally within the entire duration of service life of units which are not required to leave the berth during unfavourable weather conditions, unless it is planned to do so. This will suggest mooring systems at the following inshore/at-shore facilities (where units' offloading manifolds are often connected to a distribution facility onshore through marine loading arms or flexible hoses):

- Jetty, which is a structure providing berths at some distance from the shore. A jetty may be connected to the shore by a causeway, or may be of the island type.
- Quay, which is a berth structure backing on to the shore or reclaimed land.
- Dolphin, which is an isolated structure or strongpoint to facilitate holding a unit in position at its berth; with bollards or hooks for securing the unit and for preventing it from moving away from a berth due to combined wave, wind and current action.

16.1.3 The jetty/pier layout and mooring equipment arrangement and specifications, in addition to the plans and data listed in *Pt 3, Ch 10, 1.4 Plans and data submission,* will be subject to review and approval. The information and plans are to be submitted in an agreed electronic format, to cover the design review and class approval of the long-term nearshore positional mooring system.

16.2 Environment condition

16.2.1 The extreme environmental conditions applicable to the location or operating areas are to be specified, together with all operating environmental limits. Detailed specialist environmental reports are to be submitted, with sufficient supporting information to demonstrate the validity of the limiting criteria. *See Pt 3, Ch 10, 3 Environmental conditions* for more details.

16.2.2 Wave headings of all the possible direction should be considered unless limited heading angles are defined in the specialist environmental report.

16.2.3 Sea bed bathymetry may vary considerably around the units in case they are moored near the shoreline. Such a change in bathymetry may affect waves and currents. The current load can be even higher in the under-keel clearance. This should be investigated in the environmental specialist report and considered for the analysis.

16.2.4 A tsunami can have significant effects on the units. The specialist environmental report should include the likelihood of a tsunami and its effect, if applicable.

16.2.5 The design environmental combinations for permanent inshore/at-shore-moored units at exposed location could follow *Pt 3, Ch 10, 4.3 Design combinations of return periods of environmental parameters*.

16.2.6 For permanent inshore/at-shore-moored units operating in protected waters such as harbours or inland lakes, or semi-permanent units where such units need not remain at shore in adverse weather conditions, the design environmental return periods could be less as agreed with LR and shall be considered as a design limitation of the units.

16.2.7 When a unit is disconnectable and is expected to operate near other structures, return period should be at least 10 years. This is applicable, for instance, to a FSRU operating near other structures operating at another jetty in the same harbour.

16.2.8 For semi-permanent units, disconnection procedures from terminal facilities such as marine loading arms or flexible hoses are to be included in the operation manual submitted for approval. The manual at the minimum should contain:

- Environment parameter threshold to disconnect;
- Actions at incremental environment towards threshold value to disconnect (e.g. actions at incremental wind speeds before disconnection).

16.3 Mooring layout

16.3.1 The optimum restraining force distribution in mooring layout at terminal facilities, either inshore or at-shore, is provided by combined breast and spring lines arrangement. Within the context of this sub-Section:

- Breast lines are mooring lines orientated as perpendicular as possible to the longitudinal centreline of the units and as far aft and forward as possible.
- Spring lines are mooring lines orientated as parallel as possible to the longitudinal centreline of the units.

16.3.2 A mooring layout plan is to be submitted for approval. The arrangement of such combined mooring lines shall be demonstrated to be capable of:

- Maintaining excursion of units during offloading/cargo transfer operation within allowable operating envelope of gangways and access structures (if present), and marine loading arms or flexible hoses; as defined by terminal facilities administrator and/or manufacturer specifications.
- Maintaining mooring load below working load limit of mooring line and its tail component, during operation. The working load limit is to follow *Table 10.6.1 Minimum factors of safety for anchor lines for floating offshore installations at a fixed location* in *Pt 3, Ch 10, 6.2 Factor of safety - Strength*. For fibre ropes, follow *Pt 3, Ch 10, 9 Fibre ropes*.
- Maintaining restraining forces exerted to shipboard mooring fittings below their respective SWL capacities.

16.3.3 A mooring line management plan is to be provided to record lifecycle of each mooring line and to have aspects pertinent to load monitoring during operation, inspection of mooring lines, line retirement strategic plan and risk assessment on human intervention. The guidance notes by OCIMF can be adopted in this case, as agreed with LR.

16.4 Design considerations

16.4.1 The terminal mooring system is to be designed by considering as applicable, requirements of *Pt 3, Ch 10, 4 Design aspects*, *Pt 3, Ch 10, 5 Design analysis* and *Pt 3, Ch 10, 6 Anchor lines*; this shall cover verification on strength adequacy and fatigue life of mooring components including applicable factors of safety and detailed design methodology. For further reference, *see* the *ShipRight procedure for Long-Term Nearshore Positional Mooring System* associated with this Section of the Rules.

16.4.2 The corrosion and wear should be considered for mooring system design.

16.4.3 For nearshore positional mooring system with novel features, the design considerations and methodology should be reviewed and agreed by LR.

16.4.4 The effect of passing vessel on nearshore positional mooring system should be considered and the loads induced by passing vessel shall be combined with relevant environmental conditions.

16.4.5 The effects of long period waves such as infragravity waves, that could force seiching especially in certain enclosed mooring terminal, as well as further impact of infragravity waves which may be free or bound to sea and swell waves, should be considered.

16.4.6 In the location where snow or ice can be accreting, the effect should be considered in the design and analysis.

16.4.7 Sea bed bathymetry may affect waves and currents in case the floating system is moored near the shoreline. Such an effect should be taken into account for the design.

16.4.8 UV degradation and high temperature for the mooring lines above the water can reduce the mooring strength and fatigue capacities especially on fibre ropes and should be considered during the design.

16.4.9 The above water components of the mooring system especially fibre ropes are vulnerable to fire and blast. This can particularly be an issue for jetty moored FLNG units with large topsides processing facilities where there may be jet fire scenarios which the mooring system should survive. This risk should be considered during the design for accidental and post-accidental fire and blast design conditions.

16.5 Mooring winches

16.5.1 The specifications and performance of mooring winch for terminal mooring system shall follow *Pt 3, Ch 10, 11 Anchor winches and windlasses.* Design load cases for mooring winches are given in *Table 10.11.1 Design load cases*.

16.5.2 The associated maximum allowable stresses are to be based on the factors of safety given in *Table 10.11.2 Load case factors of safety*.

16.6 Mooring fittings and components

16.6.1 The design and specification of mooring components shall comply with *Pt 3, Ch 10, 6 Anchor lines* and *Pt 3, Ch 10, 10 Fairleads, bending shoes and stoppers.*

16.6.2 The design and specification of mooring fittings shall ensure that mooring fittings and supporting structure to which they are attached do not suffer structural damage before the mooring line breaks.

16.6.3 The design and construction of mooring fittings and their supporting hull structure are to comply with *Pt 4, Ch 6, 1.1 General 1.1.6*.

16.7 Mooring terminal facilities

16.7.1 Safety aspects in designing mooring at terminal facilities should be put in place, including access by emergency services, escape routes from hazardous areas and the provision of fire-fighting equipment.

16.7.2 Although design aspects of mooring terminal facilities are excluded in this Section, LR shall consider recognised standards and/or guidelines which provide recommendations and initial design strategy to build, maintain and refurbish mooring terminals. Provided that the level of safety is agreed by LR, the followings publications could be adopted:

- BS 6349-2:2019, Maritime works, Part 2: *Code of practice for the design of quay walls, jetties and dolphin*;
- A number of related publications by working groups under Association for Waterborne Transport Infrastructures (PIANC), e.g. PIANC Report 153: Recommendations for the Design and Assessment of Marine Oil and Petrochemical Terminals, and PIANC Report 116: Safety Aspects affecting the Berthing Operations of Tankers to Oil and Gas Terminals;
- OCIMF MEG4, 4th edition 2018, Section 9.5 pertinent to quick release hooks and bollards.

Part 3, Chapter 11
Lifting Appliances and Support Arrangements

■ *Section 1*
Rule application

1.6 Lifting lugs or padeyes

1.6.1 ~~Padeyes~~ Lifting lugs or padeyes attached to the ~~main~~ hull structure which are to be used with a rated lifting appliance are to be proof tested after installation and marked with the safe working load (SWL). The proof load is not to be less than 1,5 x SWL.

1.6.2 Lifting lugs or padeyes are to be permanently marked with the SWL, tested after installation and NDE to the Surveyor's satisfaction. In agreement with LR, testing and NDE after testing of lifting lugs or padeyes with SWL ~~<~~≤ 1 tonne may be by sampling, provided design calculations can demonstrate a factor of safety greater than 2.

Part 7, Chapter 2
Hazardous Areas and Ventilation

■ *Section 8*
Electrical equipment for use in explosive gas atmospheres

8.1 General

8.1.1 The requirements for electrical equipment for use in explosive gas atmospheres are given in *Pt 6, Ch 2, 14.1 General*, *Pt 6, Ch 2, 14.3 Selection of equipment for use in explosive gas atmospheres* and *Pt 6, Ch 2, 14.9 Cable and cable installation* of the ~~*Rules and Regulations for the Classification of Ships* (hereinafter referred to as the Rules for Ships)~~ *Rules and Regulations for the Classification of Ships, July 2019*, which are to be complied with where applicable.

8.1.6 Any electrical equipment which has to remain operational during a Major Accident Event (e.g. rupture of a process vessel or pipe), whether or not installed in a hazardous zone or location, is to be suitable for use in an explosive gas atmosphere. Such equipment is to be of a type permitted within Zone 1 locations, unless it is demonstrated that the equipment is appropriately protected against potentially coming into contact with a flammable atmosphere by being located in an enclosed safe area with appropriate mitigating measures ~~(i.e. enclosed safe area is equipped with gastight barriers, gastight doors, rated gas dampers, suitable gas detection within the enclosure and its ventilation air intakes, etc.~~). Mitigation methods acceptable to LR for enclosed safe areas may include, but are not limited to: installation of suitably sealed barriers and doors, sealing to a suitable level of smoke and gas tightness; rated gas dampers; suitable gas detection located at associated air intake ducts, main access doorways, located within the enclosure; positive pressurisation. Other arrangements may also be submitted for consideration by LR.

Part 7, Chapter 3
Fire Safety

■ *Section 3*
Additional requirements for units with drilling and/or production and process plant or pipe-laying system

3.4 Water deluge systems, water monitors and foam systems

3.4.11 Fixed fire extinguishing systems on drilling areas on mobile offshore drilling units should be in accordance with *2009 MODU Code - Code for the Construction and Equipment of Mobile Offshore Drilling Units, 2009 – Resolution A.1023(26) Chapter 9 - Fire Safety*, for fire-fighting facilities. In particular they should be provided with:

(a) A fixed water spray system to provide ~~protect~~ protection to the drilling area (drill floor) and related equipment, including emergency shutdown equipment, critical structural components, and enclosure fire barriers. The minimum water application rate is not less than 20~~.~~4 l/min **/** m^2, or

(b) At least two dual-purpose (jet/spray) fire monitors are to be installed to cover drilling and well test areas. The minimum capacity of each monitor is not less than ~~100m^3/h~~1,900 l/min at 1 N/mm^2 arranged such that all areas and equipment can be reached by at least two monitors which are widely separated**.** ~~The monitors may be operated either remotely or locally. Monitors arranged for local operation should be sited on an accessible protected position.~~

3.6 Passive fire protection

3.6.3 For fire rated divisions, bulkhead and decks, further reference should also be made to the guidance given in *SOLAS - International Convention for the Safety of Life at Sea Chapter II-2 - Construction – Fire protection, fire detection and fire extinction, Part C - Suppression of fire - Regulation 9 - Containment of fire*, as applicable to the design intent of the unit. For mobile offshore drilling units, reference also needs to be made to the various requirements within the *2009 MODU Code - Code for the Construction and Equipment of Mobile Offshore Drilling Units, 2009 – Resolution A.1023(26) Chapter 9 - Fire Safety*.

3.9 Helicopter facilities

3.9.1 ~~Fire fighting~~ Fire-fighting facilities for helidecks and any helicopter refuelling equipment should be in compliance with a recognised standard (i.e. UK CAA CAP 437 or *SOLAS - International Convention for the Safety of Life at Sea Chapter II-2 - Construction - Fire protection, fire detection and fire extinction, Part G - Special requirements, Regulation 18 - Helicopter facilities*, *Chapter 17 of the Fire Safety System (FSS) Code*). For mobile offshore drilling units reference also needs to be made to the various requirements within the *2009 MODU Code - Code for the Construction and Equipment of Mobile Offshore Drilling Units, 2009 – Resolution A.1023(26) Chapter 9 - Fire Safety* for ~~fire fighting~~ fire-fighting facilities.

3.9.3 Helidecks markings and lights should be in compliance with a recognised standard (i.e. UK CAA CAP 437). For mobile offshore drilling units reference also needs to be made to the various requirements within the *2009 MODU Code – Code for the Construction and Equipment of Mobile Offshore Drilling Units, 2009 – Resolution A.1023(26) Chapter 13 – Helicopter Facilities*. Other standards, for example relevant national standards where the unit is operating, may also be applicable. As such, other relevant standards may need to be complied with, rather than CAP 437 and the MODU Code.

Part 10, Chapter 1
General Requirements

■ *Section 5*
Structural design – New-build units

5.2 Hull scantlings

~~5.2.5 For initial design purposes, site-specific environmental factors are given in *Pt 10, Ch 2, 3.3 Environmental factors* with the associated Dynamic Load Combination factors (DLCF) given in *Pt 10, Ch 2, 7 Environmental loads for unrestricted worldwide transit condition* for the unrestricted worldwide transit condition and *Pt 10, Ch 2, 8 Environmental loads for site-specific load scenarios* for the On-site Operational condition.~~

~~5.2.6 For the final design, the loads derived in accordance with the LR ShipRight Procedure for Ship Units must be used.~~

5.2.5 For design purposes, site-specific environmental factors and Dynamic Load Combination factors (DLCF) derived in accordance with the LR ShipRight *Procedure for Ship Units* should be used for hull scantlings.

5.2.6 For site-specific environmental factors, the given factors in *Pt 10, Ch 2, 3.3 Environmental factors* are acceptable to use for the geographic locations of the sites.

5.2.7 For DLCFs, the given factors in *Pt 10, Ch 4 Dynamic Load Combination Factors* can be applicable for design purposes under class agreement, considering the site-specific condition, mooring method and size of the units. It is recommended that the designer consults with Lloyd's Register (hereinafter referred to as LR) on the conditions of application, early on in the design stage.

Part 10, Chapter 2
Loads and Load Combinations

■ *Section 3*
Dynamic load components

3.3 Environmental factors

3.3.2 For ~~initial~~ design purposes, the environmental factors considering motion are specified in *Table 2.3.2 Environmental factors*. For sites not included in *Table 2.3.2 Environmental factors*, the factors are to be calculated in accordance with the LR ShipRight *Procedure for Ship Units*.

3.3.3 The environmental factors for the operational condition may be used ~~for the initial design of units~~ for the inspection/maintenance case. The environmental factors for the deep draught for the operational condition may be used ~~for the initial design of units~~ for the flooded case.

■ *Section 4*
Sloshing and impact loads

4.2 Bottom and bilge slamming loads

(Part only shown)
4.2.2 **Slamming pressure.**
(a) The bottom slamming pressure, P_{slm}, is to be taken as the greater of:

$f_{Env-Pex-dyn}$ = environmental factor due to dynamic wave pressure. ~~For the initial design of units to be taken as that derived for the light load draught in *Table 2.3.2 Environmental factors*~~

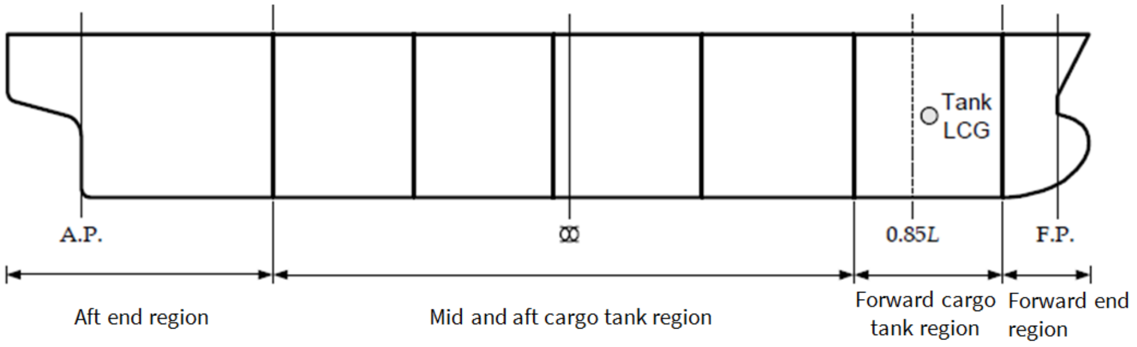
4.3 Bow impact loads

(Part only shown)
4.3.2 ~~Bow impact pressure.~~ **Bow impact pressure.**
(a) The bow impact pressure, P_{im} , is to be taken as:
$f_{Env-Pex-dyn}$ = environmental factor due to dynamic wave pressure.
~~F~~
~~or the initial design of units to be taken as:~~
~~$f_{Env-Pex-dyn}$ for the T_{LT} in *Table 2.3.2 Environmental factors* for the pressure calculation at the light load waterline~~
~~$f_{Env-Pex-dyn}$ for the T_{SC} in *Table 2.3.2 Environmental factors* for the pressure calculation at and above the deep load waterline~~

■ *Section 7*
Environmental loads for unrestricted worldwide transit condition

7.1 Dynamic load cases and dynamic load combination factors for strength assessment

Existing Figure 2.7.1 has been deleted and replaced with below Figure.



NOTES
1. Dynamic load cases for the mid and aft cargo tank region are applicable to tanks and spaces for the mid and aft cargo tank region.
2. Dynamic load cases for the aft end region are applicable to machinery spaces and other spaces aft of the mid and aft cargo tank region.
3. Dynamic load cases for the forward end region are applicable to tanks and spaces with their longitudinal centre of gravity position forward of 0,85*L* from A.P. and forward the mid cargo tank region.

Figure 2.7.1 Illustration of structural regions for DLCF Tables

■ *Section 8*

Environmental loads for site-specific load scenarios

8.1 Site-specific dynamic load combination factors

(Part only shown)

8.1.1 **Application.**

(f) Dynamic Load Combination Factor (DLCF) Tables are specified in Appendix A for the geographic locations shown in *Table 2.3.2 Environmental factors* in *Pt 10, Ch 2 Loads and Load Combinations*. These Tables may be used for the ~~initial design of~~ units operating at these locations. The Tables may be used for on-site operation and inspection/maintenance load scenarios. The deep draught DLCF Table for the operational condition may be used ~~for the initial design of units~~ for the flooded case.

The DLCF Tables are dependent on the longitudinal position being considered. The Tables given in P*t 10, Ch 4 Dynamic Load Combination Factors* have been derived for the longitudinal positions specified in *Figure 2.7.1 Illustration of structural regions for DLCF Tables*, for light load and deep load draughts.

The DLCF Tables for a novel design that differs significantly from the hull configuration covered by *Pt 10, Ch 3, Table 3.1.2 Shear force distribution factors* shall be derived by direct calculation in accordance with the LR ShipRight *Procedure for Ship Units*.

Part 10, Chapter 3
Scantling Requirements

■ *Section 1*

Scantling requirements

1.10 Intersections of continuous local support members and primary support members

(Part only shown)

Table 3.1.7 Weld factors for connection between stiffeners and primary support members

Item	Weld factor
Primary support member stiffener to intersecting stiffener	~~0,6 σ_w/σ_{perm} not to be less than 0,38~~ 0,44 σ_w/σ_{perm} not to be less than 0,34
Shear connection inclusive lug or collar plate	~~0,38~~ 0,34
Shear connection inclusive lug or collar plate, where the web stiffener of the primary support member is not connected to the intersection stiffener	~~0,6 σ_w/σ_{perm} not to be less than 0,44~~ 0,44 τ_w / τ_{perm} not to be less than 0,38
Symbol	
τ_w = shear stress, as defined in *Pt 10, Ch 3, 1.10 Intersections of continuous local support members and primary support members 1.10.3.(e)* σ_w = direct stress, as defined in *Pt 10, Ch 3, 1.10 Intersections of continuous local support members and primary support members 1.10.3.(e)* τ_{perm} = permissible shear stress, in N/mm^2, ~~see~~ *see Table 3.1.6 Permissible stresses for connection between stiffeners and primary support members* σ_{perm} = permissible direct stress, in N/mm^2, ~~see~~ *see Table 3.1.6 Permissible stresses for connection between stiffeners and primary support members*	

Part 10, Chapter 4
Dynamic Load Combination Factors

■ *Section 1*

General

1.1 Application

(Part only shown)

1.1.1 This ~~Appendix~~ Chapter contains Dynamic Load Combination Factor (DLCF) Tables for:

Table 4.1.1 Index to Dynamic Load Combination Factor Tables ~~for initial design~~

Unit size and operating condition	Environment *see* Note 1	Scantling assessment				Strength assessment by FEM
		Draught	Aft end region	Central tank	Forward end	

				region	region	
Aframax ~~or VLCC~~ Transit	Unrestricted worldwide	Deep	Table 4.1.2	Table 4.1.3	Table 4.1.4	Table 4.1.~~50~~62
		Light	Table 4.1.5	Table 4.1.6	Table 4.1.7	
Aframax Weather vaning	West of Shetland Is.	Deep	Table 4.1.8	Table 4.1.9	Table 4.1.10	Table 4.1.~~51~~63
		Light	Table 4.1.11	Table 4.1.12	Table 4.1.13	
	North Sea	Deep	Table 4.1.14	Table 4.1.15	Table 4.1.16	Table 4.1.~~52~~64
		Light	Table 4.1.17	Table 4.1.18	Table 4.1.19	
	Brazil Campos Basin	Deep	Table 4.1.20	Table 4.1.21	Table 4.1.22	Table 4.1.~~53~~65
		Light	Table 4.1.23	Table 4.1.24	Table 4.1.25	
	Western Australia (non-cyclonic)	Deep	Table 4.1.26	Table 4.1.27	Table 4.1.28	Table 4.1.~~54~~66
		Light	Table 4.1.29	Table 4.1.30	Table 4.1.31	
VLCC Weather vaning	Brazil Campos Basin	Deep	Table 4.1.32	Table 4.1.33	Table 4.1.34	Table 4.1.~~55~~67
		Light	Table 4.1.35	Table 4.1.36	Table 4.1.37	
	Western Australia (non-cyclonic)	Deep	Table 4.1.38	Table 4.1.39	Table 4.1.40	Table 4.1.~~56~~68
		Light	Table 4.1.41	Table 4.1.42	Table 4.1.43	
VLCC Spread moored	Nigeria	Deep	Table 4.1.44	Table 4.1.45	Table 4.1.46	Table 4.1.~~57~~69
		Light	Table 4.1.47	Table 4.1.48	Table 4.1.49	
Unit length 300m and above Transit	Unrestricted world wide	Deep	Table 4.1.50	Table 4.1.51	Table 4.1.52	Table 4.1.70
		Light	Table 4.1.53	Table 4.1.54	Table 4.1.55	
Unit length 300m and above Weather vaning	Benign and moderate	Deep	Table 4.1.56	Table 4.1.57	Table 4.1.58	Table 4.1.71
		Light	Table 4.1.59	Table 4.1.60	Table 4.1.61	
NOTE The geographic locations of the sites at which long-term environmental data has been used to derive the DLCF Tables are shown in *Table 2.3.2 Environmental factors*.						

(Part only shown)

Table 4.1.3 Dynamic load cases for central tank region for deep draught condition, unrestricted worldwide transit

Wave direction	Head sea		Beam sea					
Max response	M_{WV}	a_v	a_t		P_{ctr}		P_{WL}	
Dynamic load case	1	2	3S	3P	4S	4P	5S	5P
f_{mv}	1,0	–1,0	–0,1	–0,1	–0,2	–0,2	~~0,3~~ –0,3	~~0,3~~ –0,3

(Part only shown)

Table 4.1.8 Dynamic load cases for aft region for deep draught condition for a weather vaning aframax unit, west of Shetland Is.

Max response	P_{ctr}	P_{WL}		a_V		a_t	
Dynamic load case	1	2S	2P	3S	3P	4S	4P
$f_{WL\text{-}stb}$	0,7	1,0	1,0	–0,7	—0,4	~~–0,4~~ –0,6	0,4

(Part only shown)

Table 4.1.34 Dynamic load cases for forward end region for deep draught condition for a weather vaning VLCC unit, Brazil Campos Basin

Max response	a_V	a_{lng}	P_{ctr}		P_{bilge}		P_{WL}		a_t	
Dynamic load case	1	2	3S	3P	4S	4P	5S	5P	6S	6P
f_{mh}	–0,2	0.0	–0,1	0,1	–0,1	0,1	–0,1	0,1	–0,5	0,5
f_t	0,3	0.0	0,1	–0,1	0,1	–0,1	0,1	–0,1	1,0	–1,0

(Part only shown)

Table 4.1.36 Dynamic load cases for central tank region for light draught condition for a weather vaning VLCC unit, Campos Basin

Max response	M_{WV}	a_V	a_{lng}	M_{wv-h}		a_t		P_{ctr}		P_{wl}	
Dynamic load case	1(Hog)	2	3	4S	4P	5S	5P	6S	6P	7S	7P
f_t	0,0	–0,2	0,0	0,2	–0,2	1,0	–1,0	0,1	–0,1	0,1	–0,1

(Part only shown)

Table 4.1.37 Dynamic load cases for forward end region for light draught condition for a weather vaning VLCC unit, Brazil Campos Basin

Max response	a_V	a_{lng}	P_{ctr}		P_{bilge}		P_{WL}		a_t	
Dynamic load case	1	2	3S	3P	4S	4P	5S	5P	6S	6P
f_t	0,3	0,0	0,1	–0,1	0,1	–0,1	0,1	–0,1	1,0	–1,0

Table 4.1.50 Dynamic load cases for aft end region for deep draught condition for unrestricted worldwide transit of the unit length 300m and above

Max response	P_{ctr}	P_{wl}		a_v		a_t	
Dynamic load case	1	2S	2P	3S	3P	4S	4P
f_{mv}	-1,0	-0,7	-0,7	-0,4	-0,4	-0,1	-0,1
f_{mh}	0,0	0,1	-0,1	0,1	-0,1	0,0	0,0
f_{v-mid}	0,6	0,9	0,9	1,0	1,0	0,3	0,3
f_{v-pt}	0,6	0,9	0,9	1,0	1,0	0,4	0,4
f_{v-stb}	0,6	0,9	0,9	1,0	1,0	0,4	0,4
f_t	0,0	0,4	-0,4	0,5	-0,5	1,0	-1,0
$f_{lng-mid}$	0,8	0,7	0,7	0,6	0,6	-0,1	-0,1
f_{lng-pt}	0,8	0,7	0,7	0,6	0,6	-0,1	-0,1
$f_{lng-stb}$	0,8	0,7	0,7	0,6	0,6	-0,1	-0,1
$f_{lng-ctr}$	0,8	0,7	0,7	0,6	0,6	-0,1	-0,1
$f_{ctr-stb}$	1,0	0,7	0,7	0,7	0,7	0,2	0,2
$f_{bilge-stb}$	0,3	0,5	0,3	0,6	0,3	0,5	-0,4
f_{WL-stb}	0,5	1,0	0,4	0,8	0,3	0,5	-0,3
f_{ctr-pt}	1,0	0,7	0,7	0,7	0,7	0,2	0,2
$f_{bilge-pt}$	0,3	0,3	0,5	0,3	0,6	-0,4	0,5
f_{WL-pt}	0,5	0,4	1,0	0,3	0,8	-0,3	0,5

Table 4.1.51 Dynamic load cases for central tank region for deep draught condition for unrestricted worldwide transit of the unit length 300m and above

Max response	M_{wv}	a_v		a_{lng}		M_{wv-h}		a_t		P_{ctr}		P_{wl}	
Dynamic load case	1S	2S	2P	3S	3P	4S	4P	5S	5P	6S	6P	7S	7P
f_{mv}	1,0	-0,5	-0,5	-0,7	-0,7	-0,2	-0,2	-0,1	-0,1	-1,0	-1,0	-0,3	-0,3
f_{mh}	-0,25	0,0	0,0	0,4	-0,4	1,0	-1,0	-0,1	0,1	0,0	0,0	0,0	0,0
f_{v-mid}	-0,2	1,0	1,0	-04	-0,4	-0,1	-0,1	0,5	0,5	1,0	1,0	1,0	1,0
f_{v-pt}	-0,2	1,0	1,0	-0,4	-0,4	-0,1	-0,1	0,2	0,6	0,8	1,0	1,0	1,0
f_{v-stb}	-0,2	1,0	1,0	-0,4	-0,4	-0,1	-0,1	0,6	0,2	1,0	0,8	1,0	1,0
f_t	0,0	0,3	-0,3	0,2	-0,2	0,0	0,0	1,0	-1,0	0,5	-0,5	0,6	-0,6
$f_{lng-mid}$	0,3	-0,6	-0,6	1,0	1,0	-0,5	-0,5	-0,1	-0,1	-0,5	-0,5	-0,6	-0,6
f_{lng-pt}	0,3	-0,6	-0,6	1,0	1,0	-0,4	-0,2	-0,1	-0,1	-0,5	-0,5	-0,6	-0,6
$f_{lng-stb}$	0,3	-0,6	-0,6	1,0	1,0	-0,2	-0,4	-0,1	-0,1	-0,5	-0,5	-0,6	-0,6
$f_{lng-ctr}$	0,3	-0,6	-0,6	1,0	1,0	-0,5	-0,5	-0,1	-0,1	-0,5	-0,5	-0,6	-0,6
$f_{ctr-stb}$	0,7	-0,6	-0,6	0,4	0,4	-0,8	-0,8	0,5	0,5	1,0	1,0	0,9	0,9
$f_{bilge-stb}$	0,3	-0,6	-0,4	0,5	-0,4	-0,5	0,1	0,8	-0,5	0,9	0,4	1,0	0,4

f_{WL-stb}	0,3	-0,6	-0,4	0,2	-0,2	-0,8	0,1	0,5	-0,45	0,8	0,4	1,0	0,4
f_{ctr-pt}	0,7	-0,6	-0,6	0,4	0,4	-0,8	-0,8	0,5	0,5	1,0	1,0	0,9	0,9
$f_{bilge-pt}$	0,3	-0,4	-0,6	-0,4	0,5	-0,1	-0,5	-0,5	0,8	0,4	0,9	0,4	1,0
f_{WL-pt}	0,3	-0,4	-0,6	-0,2	0,2	-0,1	-0,8	-0,45	0,5	0,4	0,8	0,4	1,0

Table 4.1.52 Dynamic load cases for forward end region for deep draught condition for unrestricted worldwide transit of the unit length 300m and above

Max response	a_v	a_{lng}	a_{lng}		P_{ctr}		P_{bilge}		P_{wl}		a_v		a_t	
Dynamic load case	1	2	3S	3P	4S	4P	5S	5P	6S	6P	7S	7P	8S	8P
f_{mv}	-0,7	0,9	0,3	0,3	-0,6	-0,6	-0,3	-0,3	-0,1	-0,1	-0,4	-0,4	-0,1	-0,1
f_{mh}	0,0	0,0	-0,4	0,4	0,2	-0,2	-0,4	0,4	-0,1	0,1	-0,1	0,1	-0,5	0,5
f_{v-mid}	0,7	-0,6	-0,6	-0,6	0,7	0,7	0,9	0,9	0,5	0,5	1,0	1,0	0,4	0,4
f_{v-pt}	0,7	-0,6	-0,6	-0,6	0,7	0,7	0,9	1,0	0,2	0,6	0,9	1,0	0,3	0,6
f_{v-stb}	0,7	-0,6	-0,6	-0,6	0,7	0,7	1,0	0,9	0,6	0,2	1,0	0,9	0,6	0,3
f_t	0,0	0,0	-0,5	0,5	0,1	-0,1	0,7	-0,7	1,0	-1,0	0,6	-0,6	1,0	-1,0
$f_{lng-mid}$	-0,8	1,0	0,8	0,8	-1,0	-1,0	-0,5	-0,5	-0,1	-0,1	-0,5	-0,5	-0,1	-0,1
f_{lng-pt}	-0,8	1,0	1,0	0,6	-1,0	-0,9	-0,5	-0,5	-0,1	-0,1	-0,5	-0,5	-0,1	-0,1
$f_{lng-stb}$	-0,8	1,0	0,6	1,0	-0,9	-1,0	-0,5	-0,5	-0,1	-0,1	-0,5	-0,5	-0,1	-0,1
$f_{lng-ctr}$	-0,8	1,0	0,8	0,8	-1,0	-1,0	-0,5	-0,5	-0,1	-0,1	-0,5	-0,5	-0,1	-0,1
$f_{ctr-stb}$	1,0	-0,9	-0,4	-0,4	1,0	1,0	0,8	0,8	0,5	0,5	0,8	0,8	0,4	0,4
$f_{bilge-stb}$	0,6	-0,7	-0,6	-0,4	0,9	0,6	1,0	0,5	0,7	0,3	1,0	0,5	0,8	-0,2
f_{WL-stb}	0,3	-0,5	-0,9	-0,2	0,8	0,4	0,9	0,4	1,0	0,4	0,9	0,4	0,6	-0,4
f_{ctr-pt}	1,0	-0,9	-0,4	-0,4	1,0	1,0	0,8	0,8	0,5	0,5	0,8	0,8	0,4	0,4
$f_{bilge-pt}$	0,6	-0,7	-0,4	-0,6	0,6	0,9	0,5	1,0	0,3	0,7	0,5	1,0	-0,2	0,8
f_{WL-pt}	0,3	-0,5	-0,2	-0,9	0,4	0,8	0,4	0,9	0,4	1,0	0,4	0,9	-0,4	0,6

Table 4.1.53 Dynamic load cases for aft end region for light draught condition for unrestricted worldwide transit of the unit length 300m and above

Max response	P_{ctr}	P_{wl}		a_v		a_t	
Dynamic load case	1	2S	2P	3S	3P	4S	4P
f_{mv}	-1,0	-0,6	-0,6	0,3	0,3	0,1	0,1
f_{mh}	0,3	0,2	-0,2	0,2	-0,2	0,1	0,1
f_{v-mid}	0,6	0,9	0,9	1,0	1,0	0,3	0,3
f_{v-pt}	0,6	0,9	0,9	1,0	1,0	0,3	0,5
f_{v-stb}	0,6	0,9	0,9	1,0	1,0	0,5	0,3
f_t	0,0	0,1	-0,1	0,6	-0,6	1,0	-1,0
$f_{lng-mid}$	0,7	0,8	0,8	0,5	0,5	0,0	0,0
f_{lng-pt}	0,7	0,8	0,8	0,5	0,5	0,0	0,0
$f_{lng-stb}$	0,7	0,8	0,8	0,5	0,5	0,0	0,0
$f_{lng-ctr}$	0,7	0,8	0,8	0,5	0,5	0,0	0,0
$f_{ctr-stb}$	1,0	0,6	0,6	0,5	0,5	0,1	0,1
$f_{bilge-stb}$	0,5	0,4	0,1	0,7	0,2	0,5	-0,3
f_{WL-stb}	0,8	1,0	0,3	0,8	0,45	0,5	-0,4
f_{ctr-pt}	1,0	0,6	0,6	0,5	0,5	0,1	0,1
$f_{bilge-pt}$	0,5	0,1	0,4	0,2	0,7	-0,3	0,5
f_{WL-pt}	0,8	0,3	1,0	0,45	0,8	-0,4	0,5

Table 4.1.54 Dynamic load cases for central tank region for light draught condition for unrestricted worldwide transit of the unit length 300m and above

Max response	M_{wv}	a_v		a_{lng}	M_{wv-h}		a_t		P_{ctr}		P_{wl}	
Dynamic load case	1,0	2S	2P	3	4S	4P	5S	5P	6S	6P	7S	7P
f_{mv}	1,0	-1,0	-1,0	0,5	-0,7	-0,7	-0,2	-0,2	-1,0	-1,0	-0,35	-0,35
f_{mh}	-0,3	0,0	0,0	0,0	1,0	-1,0	0,1	0,1	-0,1	0,1	-0,2	0,2
f_{v-mid}	-0,1	1,0	1,0	-0,3	0,2	0,2	0,5	0,5	1,0	1,0	1,0	1,0
f_{v-pt}	-0,1	1,0	1,0	-0,3	0,2	0,2	0,5	0,8	1,0	1,0	1,0	1,0
f_{v-stb}	-0,1	1,0	1,0	-0,3	0,2	0,2	0,8	0,5	1,0	1,0	1,0	1,0
f_t	0,0	0,5	-0,5	-0,4	0,0	0,0	1,0	-1,0	0,8	-0,8	0,6	-0,6
$f_{lng-mid}$	0,2	-0,1	-0,1	1,0	-0,6	-0,6	0,0	0,0	-0,2	-0,2	0,1	-0,1
f_{lng-pt}	0,2	-0,1	-0,1	1,0	-0,6	-0,4	0,0	0,0	-0,2	-0,2	0,1	-0,1
$f_{lng-stb}$	0,2	-0,1	-0,1	1,0	-0,4	-0,6	0,0	0,0	-0,2	-0,2	0,1	-0,1
$f_{lng-ctr}$	0,2	-0,1	-0,1	1,0	-0,4	-0,4	0,0	0,0	-0,2	-0,2	0,1	-0,1
$f_{ctr-stb}$	1,0	0,8	0,8	0,4	-0,5	-0,5	0,3	0,3	0,8	0,8	0,8	0,8
$f_{bilge-stb}$	0,3	0,9	0,6	0,5	-0,6	0,1	0,9	-0,4	0,9	0,4	1,0	0,7
f_{WL-stb}	0,3	0,8	0,5	0,6	-0,7	0,2	0,7	-0,4	0,9	0,4	1,0	0,5
f_{ctr-pt}	1,0	0,8	0,8	0,4	-0,5	-0,5	0,3	0,3	0,8	0,8	0,8	0,8
$f_{bilge-pt}$	0,3	0,6	0,9	0,5	0,1	-0,6	-0,4	0,9	0,4	0,9	0,7	1,0
f_{WL-pt}	0,3	0,5	0,8	0,6	0,2	-0,7	-0,4	0,7	0,4	0,9	0,5	1,0

Table 4.1.55 Dynamic load cases for forward end region for light draught condition for unrestricted worldwide transit of the unit length 300m and above

Max response	a_v	a_{lng}	a_{lng}		P_{ctr}		P_{bilge}		P_{wl}		a_v		a_t	
Dynamic load case	1	2	3S	3P	4S	4P	5S	5P	6S	6P	7S	7P	8S	8P
f_{mv}	-0,8	0,9	0,7	0,7	-1,0	-1,0	-0,2	-0,2	-0,3	-0,3	-0,15	-0,15	-0,1	-0,1
f_{mh}	0,0	0,0	-0,4	0,4	0,0	0,0	-0,5	0,5	0,3	-0,3	-0,4	0,4	-0,4	0,4
f_{v-mid}	0,7	-0,6	-0,7	-0,7	0,4	0,4	0,6	0,6	0,9	0,9	1,0	1,0	0,4	0,4
f_{v-pt}	0,7	-0,6	-0,7	-0,7	0,4	0,4	0,3	0,8	0,7	0,7	0,5	1,0	0,4	0,7
f_{v-stb}	0,7	-0,6	-0,7	-0,7	0,4	0,4	0,8	0,3	0,7	0,7	1,0	0,5	0,7	0,4
f_t	0,0	0,0	-0,6	-0,6	0,0	0,0	0,9	-0,9	0,35	-0,35	0,7	-0,7	1,0	-1,0
$f_{lng-mid}$	-0,9	1,0	1,0	1,0	-0,6	-0,6	-0,3	-0,3	-0,9	-0,9	0,0	0,0	0,0	0,0
f_{lng-pt}	-0,9	1,0	1,0	1,0	-0,6	-0,6	-0,5	0,3	-0,9	-0,9	0,5	0,0	0,0	0,0
$f_{lng-stb}$	-0,9	1,0	1,0	1,0	-0,6	-0,6	0,3	-0,5	-0,6	-0,9	0,0	0,5	0,0	0,0
$f_{lng-ctr}$	-0,9	1,0	1,0	1,0	-0,6	-0,6	-0,3	-0,3	-0,9	-0,9	0,5	0,5	0,0	0,0
$f_{ctr-stb}$	1,0	-0,7	-0,9	-0,9	1,0	1,0	0,6	0,6	0,6	0,6	0,4	0,4	0,2	0,2
$f_{bilge-stb}$	0,5	-0,4	-0,7	-0,3	0,6	0,6	1,0	-0,3	0,9	0,2	0,8	0,2	0,7	-0,3
f_{WL-stb}	0,3	-0,2	-0,6	0,3	0,4	0,4	0,9	-0,3	1,0	0,3	0,8	0,4	0,7	-0,4
f_{ctr-pt}	1,0	-0,7	-0,9	-0,9	1,0	1,0	0,6	0,6	0,6	0,6	0,4	0,4	0,2	0,2
$f_{bilge-pt}$	0,5	-0,4	-0,3	-0,7	0,6	0,6	-0,3	1,0	0,2	0,9	0,2	0,8	-0,3	0,7
f_{WL-pt}	0,3	-0,2	0,3	-0,6	0,4	0,4	-0,3	0,9	0,3	1,0	0,4	0,8	-0,4	0,7

Table 4.1.56 Dynamic load cases for aft end region for deep draught condition for a weather vaning of the unit length 300m and above under benign and moderate condition

Max response	P_{ctr}	P_{ctr}		P_{wl}		a_v		a_{lng}		a_t	
Dynamic load case	1	2S	2P	3S	3P	4S	4P	5S	5P	6S	6P
f_{mv}	-1,0	0,6	0,6	-0,7	-0,7	-0,4	-0,4	0,7	0,7	-0,6	-0,6
f_{mh}	0,0	0,0	0,0	0,5	-0,5	0,2	-0,2	0,4	-0,4	0,3	-0,3
f_{v-mid}	0,6	1,0	1,0	0,9	0,9	1,0	1,0	0,9	0,9	0,3	0,3
f_{v-pt}	0,6	1,0	1,0	0,9	0,9	1,0	1,0	0,9	0,9	0,4	0,4

f_{v-stb}	0,6	1,0	1,0	0,9	0,9	1,0	1,0	0,9	0,9	0,4	0,4
f_{t}	0,0	0,5	-0,5	0,4	-0,4	0,8	-0,8	0,7	-0,7	1,0	-1,0
$f_{lng-mid}$	0,8	1,0	1,0	0,7	0,7	0,6	0,6	1,0	1,0	-0,1	-0,1
f_{lng-pt}	0,8	1,0	1,0	0,7	0,7	0,6	0,6	1,0	1,0	-0,1	-0,1
$f_{lng-stb}$	0,8	1,0	1,0	0,7	0,7	0,6	0,6	1,0	1,0	-0,1	-0,1
$f_{lng-ctr}$	0,8	1,0	1,0	0,7	0,7	0,6	0,6	1,0	1,0	-0,1	-0,1
$f_{ctr-stb}$	1,0	1,0	1,0	0,8	0,8	0,7	0,7	0,7	0,7	0,2	0,2
$f_{bilge-stb}$	0,3	0,4	0,2	0,8	0,6	0,6	0,4	0,4	0,2	0,4	0,1
f_{WL-stb}	0,5	0,8	0,4	1,0	0,6	0,8	0,5	1,0	0,4	0,8	-0,3
f_{ctr-pt}	1,0	1,0	1,0	0,8	0,8	0,7	0,7	0,7	0,7	0,2	0,2
$f_{bilge-pt}$	0,3	0,2	0,4	0,6	0,8	0,4	0,6	0,2	0,4	0,1	0,4
f_{WL-pt}	0,5	0,4	0,8	0,6	1,0	0,5	0,8	0,4	1,0	-0,3	0,8

Table 4.1.57 Dynamic load cases for central tank region for deep draught condition for a weather vaning of the unit length 300m and above under benign and moderate condition

Max response	M_{wv}		M_{wv-h}		a_{lng}		a_{v}	a_{t}		P_{ctr}		P_{wl}		P_{wl}	
Dynamic load case	1S	1P	2S	2P	3S	3P	4	5S	5P	6S	6P	7S	7P	8S	8P
f_{mv}	1,0	1,0	-0,65	-0,65	0,6	0,6	0,2	-0,1	-0,1	-0,5	-0,5	-0,5	-0,5	-0,3	-0,3
f_{mh}	-0,85	0,85	1,0	-1,0	-1,0	1,0	0,3	-0,1	0,1	-0,1	0,1	-1,0	1,0	-0,3	0,3
f_{v-mid}	-0,2	-0,2	-0,25	-0,25	-0,4	-0,4	1,0	0,5	0,5	1,0	1,0	-0,2	-0,2	1,0	1,0
f_{v-pt}	-0,2	-0,2	-0,25	-0,25	-0,4	-0,4	1,0	0,6	0,6	1,0	1,0	-0,2	-0,2	1,0	1,0
f_{v-stb}	-0,2	-0,2	-0,25	-0,25	-0,4	-0,4	1,0	0,6	0,6	1,0	1,0	-0,2	-0,2	1,0	1,0
f_{t}	0,0	0,0	0,3	-0,3	0,3	-0,3	0,6	1,0	-1,0	0,5	-0,5	0,2	-0,2	0,8	-0,8
$f_{lng-mid}$	0,6	0,6	-0,4	-0,4	1,0	1,0	-0,6	-0,1	-0,1	-0,5	-0,5	-0,6	-0,6	-0,6	-0,6
f_{lng-pt}	0,6	0,6	-0,4	-0,3	1,0	1,0	-0,6	-0,1	-0,1	-0,5	-0,5	-0,6	-0,6	-0,6	-0,6
$f_{lng-stb}$	0,6	0,6	-0,3	-0,4	1,0	1,0	-0,6	-0,1	-0,1	-0,5	-0,5	-0,6	-0,6	-0,6	-0,6
$f_{lng-ctr}$	0,6	0,6	-0,4	-0,4	1,0	1,0	-0,6	-0,1	-0,1	-0,5	-0,5	-0,6	-0,6	-0,6	-0,6
$f_{ctr-stb}$	0,9	0,9	-0,5	-0,5	0,4	0,4	-0,6	0,5	0,5	1,0	1,0	0,7	0,7	0,9	0,9
$f_{bilge-stb}$	0,65	0,3	-0,5	0,1	0,5	0,2	-0,6	0,8	-0,3	0,9	0,4	0,7	0,0	1,0	0,5
f_{WL-stb}	0,65	0,3	-0,6	0,1	0,5	0,2	-0,6	0,8	-0,2	0,8	0,4	1,0	-0,2	1,0	0,5
f_{ctr-pt}	0,9	0,9	-0,5	-0,5	0,4	0,4	-0,6	0,5	0,5	1,0	1,0	0,7	0,7	0,9	0,9
$f_{bilge-pt}$	0,3	0,65	0,1	-0,5	0,2	0,5	-0,6	-0,3	0,8	0,4	0,9	0	0,7	0,5	1,0
f_{WL-pt}	0,3	0,65	0,1	-0,6	0,2	0,5	-0,6	-0,2	0,8	0,4	0,8	-0,2	1,0	0,5	1,0

Table 4.1.58 Dynamic load cases for forward end region for deep draught condition for a weather vaning of the unit length 300m and above under benign and moderate condition

Max response	a_{lng}	a_{lng}		P_{ctr}		P_{wl}		a_{v}		a_{t}	
Dynamic load case	1	2S	2P	3S	3P	4S	4P	5S	5P	6S	6P
f_{mv}	0,9	0,6	0,6	-0,6	-0,6	-0,1	-0,1	-0,4	-0,4	-0,1	-0,1
f_{mh}	0,0	-0,4	0,4	0,2	-0,2	0,25	-0,25	-0,4	0,4	-0,5	0,5
f_{v-mid}	-0,6	-0,6	-0,6	0,7	0,7	0,5	0,5	1,0	1,0	0,4	0,4
f_{v-pt}	-0,6	-0,6	-0,6	0,7	0,7	0,2	0,6	1,0	1,0	0,4	0,6
f_{v-stb}	-0,6	-0,6	-0,6	0,7	0,7	0,6	0,2	1,0	1,0	0,6	0,4
f_{t}	0,0	0,5	-0,5	0,5	-0,5	1,0	-1,0	0,7	-0,7	1,0	-1,0
$f_{lng-mid}$	1,0	0,8	0,8	-0,5	-0,5	-0,85	-0,85	-0,7	-0,7	-0,1	-0,1
f_{lng-pt}	1,0	1,0	0,6	-0,5	-0,5	-0,85	-0,85	-0,7	-0,7	-0,1	-0,1
$f_{lng-stb}$	1,0	0,6	1,0	-0,5	-0,5	-0,85	-0,85	-0,7	-0,7	-0,1	-0,1
$f_{lng-ctr}$	1,0	0,8	0,8	-0,5	-0,5	-0,85	-0,85	-0,7	-0,7	-0,1	-0,1
$f_{ctr-stb}$	-0,9	-0,4	-0,4	1,0	1,0	0,5	0,5	0,8	0,8	0,4	0,4
$f_{bilge-stb}$	-0,7	-0,6	-0,2	0,9	0,6	0,8	-0,3	1,0	0,5	0,8	-0,1

f_{WL-stb}	-0,5	-0,9	-0,3	0,8	0,4	1,0	-0,4	0,9	0,4	0,8	-0,2
f_{ctr-pt}	-0,9	-0,4	-0,4	1,0	1,0	0,5	0,5	0,8	0,8	0,4	0,4
$f_{bilge-pt}$	-0,7	-0,2	-0,6	0,6	0,9	-0,3	0,8	0,5	1,0	-0,1	0,8
f_{WL-pt}	-0,5	-0,3	-0,9	0,4	0,8	-0,4	1,0	0,4	0,9	-0,2	0,8

Table 4.1.59 Dynamic load cases for aft end region for light draught condition for a weather vaning of the unit length 300m and above under benign and moderate condition

Max response	P_{ctr}	P_{ctr}		P_{wl}		a_v		a_t		a_t	
Dynamic load case	1	2S	2P	3S	3P	4S	4P	5S	5P	6S	6P
f_{mv}	1,0	0,5	0,5	0,3	0,3	0,4	0,4	0,7	0,7	0,1	0,1
f_{mh}	0,0	0,0	0,0	0,5	-0,5	0,3	-0,3	0,4	-0,4	0,2	-0,2
f_{v-mid}	0,6	1,0	1,0	-0,9	-0,9	1,0	1,0	0,3	0,3	0,4	0,4
f_{v-pt}	0,6	1,0	1,0	-0,9	-0,9	1,0	1,0	0,3	0,3	0,4	0,5
f_{v-stb}	0,6	1,0	1,0	-0,9	-0,9	1,0	1,0	0,3	0,3	0,5	0,5
f_t	0,0	0,5	-0,5	0,4	-0,4	0,6	-0,6	1,0	-1,0	1,0	-1,0
$f_{lng-mid}$	0,7	1,0	1,0	-0,5	-0,5	0,7	0,7	0,8	0,8	0,0	0,0
f_{lng-pt}	0,7	1,0	1,0	-0,5	-0,5	0,7	0,7	0,8	0,8	0,0	0,0
$f_{lng-stb}$	0,7	1,0	1,0	-0,5	-0,5	0,7	0,7	0,8	0,8	0,0	0,0
$f_{lng-ctr}$	0,7	1,0	1,0	-0,5	-0,5	0,7	0,7	0,8	0,8	0,0	0,0
$f_{ctr-stb}$	1,0	1,0	1,0	0,85	0,85	0,5	0,5	0,1	0,1	0,1	0,1
$f_{bilge-stb}$	0,3	0,5	0,2	0,8	0,2	0,3	0,2	0,2	-0,1	0,3	-0,2
f_{WL-stb}	0,8	0,9	0,4	1,0	0,6	0,8	0,3	0,4	-0,3	1,0	-0,3
f_{ctr-pt}	1,0	1,0	1,0	0,85	0,85	0,5	0,5	0,1	0,1	0,1	0,1
$f_{bilge-pt}$	0,3	0,2	0,5	0,2	0,8	0,2	0,3	-0,1	0,2	-0,2	0,3
f_{WL-pt}	0,8	0,4	0,9	0,6	1,0	0,3	0,8	-0,3	0,4	-0,3	1,0

Table 4.1.60 Dynamic load cases for central tank region for light draught condition for a weather vaning of the unit length 300m and above under benign and moderate condition

Max response	M_{wv}		M_{wv-h}		a_{lng}		a_v		a_t		P_{ctr}		P_{wl}		P_{wl}	
Dynamic load case	1S	1P	2S	2P	3S	3P	4S	4P	5S	5P	6S	6P	7S	7P	8S	8P
f_{mv}	1,0	1,0	-0,7	-0,7	0,8	0,8	-0,6	-0,6	-0,1	-0,1	-0,6	-0,6	-0,7	-0,7	-0,2	-0,2
f_{mh}	-0,85	0,85	1,0	-1,0	-0,8	0,8	-0,7	0,7	0,2	-0,2	-0,1	0,1	-1,0	1,0	-0,4	0,4
f_{v-mid}	-0,1	-0,1	0,2	0,2	-0,3	-0,3	1,0	1,0	0,5	0,5	1,0	1,0	0,2	0,2	1,0	1,0
f_{v-pt}	-0,1	-0,1	0,2	0,2	-0,3	-0,3	1,0	1,0	0,5	0,8	1,0	1,0	0,2	0,2	1,0	1,0
f_{v-stb}	-0,1	-0,1	0,2	0,2	-0,3	-0,3	1,0	1,0	0,8	0,5	1,0	1,0	0,2	0,2	1,0	1,0
f_t	0,0	0,0	0,1	-0,1	0,3	-0,3	0,4	-0,4	1,0	-1,0	0,8	-0,8	0,2	-0,2	1,0	-1,0
$f_{lng-mid}$	0,6	0,6	-0,6	-0,6	1,0	1,0	-0,6	-0,6	-0,1	-0,1	-0,8	-0,8	-0,4	-0,4	-0,1	-0,1
f_{lng-pt}	0,6	0,6	-0,6	-0,4	1,0	1,0	-0,6	-0,6	-0,1	-0,1	-0,8	-0,8	-0,4	-0,4	-0,1	-0,1
$f_{lng-stb}$	0,6	0,6	-0,4	-0,6	1,0	1,0	-0,6	-0,6	-0,1	-0,1	-0,8	-0,8	-0,4	-0,4	-0,1	-0,1
$f_{lng-ctr}$	0,6	0,6	-0,4	-0,4	1,0	1,0	-0,6	-0,6	-0,1	-0,1	-0,8	-0,8	-0,4	-0,4	-0,1	-0,1
$f_{ctr-stb}$	1,0	1,0	-0,5	-0,5	0,4	0,4	-0,8	-0,8	0,3	0,3	0,8	0,8	0,4	0,4	0,6	0,6
$f_{bilge-stb}$	0,5	0,4	-0,4	0,2	0,4	0,2	-0,8	-0,2	0,9	-0,4	0,9	0,4	0,9	0,2	0,9	0,2
f_{WL-stb}	0,65	0,4	-0,6	0,1	0,5	0,4	-0,6	-0,3	0,8	-0,4	0,9	0,4	1,0	0,2	1,0	0,4
f_{ctr-pt}	1,0	1,0	-0,5	-0,5	0,4	0,4	-0,8	-0,8	0,3	0,3	0,8	0,8	0,4	0,4	0,6	0,6
$f_{bilge-pt}$	0,4	0,5	0,2	-0,4	0,2	0,4	-0,2	-0,8	-0,4	0,9	0,4	0,9	0,2	0,9	0,2	0,9
f_{WL-pt}	0,4	0,65	0,1	-0,6	0,4	0,5	-0,3	-0,6	-0,4	0,8	0,4	0,9	0,2	1,0	0,4	1,0

Table 4.1.61 Dynamic load cases for forward end region for light draught condition for a weather vaning of the unit length 300m and above under benign and moderate condition

Max response	a_{lng}		P_{ctr}	P_{wl}		P_{wl}		a_{lng}		a_t	
Dynamic load case	1S	1P	2	4S	4P	5S	5P	6S	6P	8S	8P
f_{mv}	0,7	0,7	1,0	1,0	1,0	-0,3	-0,3	-0,1	-0,1	-0,1	-0,1
f_{mh}	-0,4	0,4	0,0	0,1	-0,1	0,3	-0,3	-0,4	0,4	-0,4	0,4
$f_{v\text{-}mid}$	-0,85	-0,85	1,0	-1,0	-1,0	1,0	1,0	-0,7	-0,7	0,4	0,4
$f_{v\text{-}pt}$	-0,85	-0,85	1,0	-1,0	-1,0	1,0	1,0	-0,7	-0,7	0	0,7
$f_{v\text{-}stb}$	-0,85	-0,85	1,0	-1,0	-1,0	1,0	1,0	-0,7	-0,7	0,7	0,0
f_t	0,4	-0,4	0,1	0,3	-0,3	1,0	-1,0	0,8	-0,8	1,0	-1,0
$f_{lng\text{-}mid}$	1,0	1,0	-0,7	0,9	0,9	-0,8	-0,8	1,0	1,0	0,0	0,0
$f_{lng\text{-}pt}$	1,0	1,0	-0,7	0,9	0,9	-0,8	-0,8	1,0	1,0	0,0	0,0
$f_{lng\text{-}stb}$	1,0	1,0	-0,7	0,9	0,9	-0,8	-0,8	1,0	1,0	0,0	0,0
$f_{lng\text{-}ctr}$	1,0	1,0	-0,8	0,9	0,9	-0,9	-0,9	1,0	1,0	0,0	0,0
$f_{ctr\text{-}stb}$	-0,9	-0,9	-1,0	0,6	0,6	0,6	0,6	-1,0	-1,0	0,4	0,4
$f_{bilge\text{-}stb}$	-0,7	-0,3	-0,6	0,9	0,6	0,9	0,2	-0,7	-0,3	0,7	-0,3
$f_{WL\text{-}stb}$	-0,6	-0,1	-0,4	1,0	0,2	1,0	0,1	-0,9	-0,3	0,8	-0,4
$f_{ctr\text{-}pt}$	-0,9	-0,9	-1,0	0,6	0,6	0,6	0,6	-1,0	-1,0	0,4	0,4
$f_{bilge\text{-}pt}$	-0,3	-0,7	-0,6	0,6	0,9	0,2	0,9	-0,3	-0,7	-0,3	0,7
$f_{WL\text{-}pt}$	-0,1	-0,6	-0,4	0,2	1,0	0,1	1,0	-0,3	-0,9	-0,4	0,8

Table ~~4.1.50~~ 4.1.62 Dynamic load cases for strength assessment ~~(~~by FEM~~),~~ for unrestricted worldwide transit

Existing Table 4.1.51 has been renumbered 4.1.63.

(Part only shown)

Table ~~4.1.52~~ 4.1.64 Dynamic load cases for strength assessment by FEM for a weather vaning aframax unit, North Sea

Max response	M_{wv} (Sagging)	M_{wv} (Hogging)	Q_{wv} (Positive)	Q_{wv} (Negative)	a_v		$M_{wv\text{-}h}$	
Dynamic load case	1	2	3	4	5S	5P	6S	6P
$f_{WL\text{-}stb}$	–0,8	0,8	–1,0	1,0	–0,5	–0,2	–0,2	0,1

(Part only shown)

Table ~~4.1.53~~ 4.1.65 Dynamic load cases for strength assessment by FEM for a weather vaning aframax unit, Brazil

Max response	M_{wv} (Sagging)	M_{wv} (Hogging)	Q_{wv} (Positive)	Q_{wv} (Negative)	a_v		$M_{wv\text{-}h}$	
Dynamic load case	1	2	3	4	5S	5P	6S	6P
$f_{WL\text{-}stb}$	–0,6	~~–0,6~~ 0,6	–0,8	0,8	–0,5	–0,2	–0,2	0,1

(Part only shown)

Table ~~4.1.54~~ 4.1.66 Dynamic load cases for strength assessment by FEM for a weather vaning aframax unit, Western Australia (non-cyclonic)

Max response	M_{wv} (Sagging)	M_{wv} (Hogging)	Q_{wv} (Positive)	Q_{wv} (Negative)	a_v		$M_{wv\text{-}h}$	
Dynamic load case	1	2	3	4	5S	5P	6S	6P
$f_{WL\text{-}stb}$	–0,4	0,4	–0,5	0,5	–0,2	–0,1	0,3	–0,1

Existing Tables 4.1.55 to 4.1.57 have been renumbered 4.1.67 to 4.1.69.

Table 4.1.70 Dynamic load cases for strength assessment by FEM for unrestricted worldwide transit of the unit length 300m and above

Max response	M_{wv} (Sagging)	M_{wv} (Hogging)	Q_{wv} (Positive)	Q_{wv} (Negative)	a_v		M_{wv-h}	
Dynamic load case	1	2	3	4	5S	5P	6S	6P
f_{mv}	1,0	-1,0	1,0	-1,0	-0,5	-0,5	-0,7	-0,7
f_{qv}	-1,0	1,0	-1,0	1,0	0,2	0,2	-0,5	-0,5
f_{mh}	-0,3	0,3	0,0	0,0	0,0	0,0	1,0	-1,0
f_v	-0,1	0,1	0,1	-0,1	1,0	1,0	0,2	0,2
f_t	0,0	0,0	0,0	0,0	0,3	-0,3	0	0
f_{lng}	0,2	-0,2	-0,9	0,9	-0,6	-0,6	-0,6	-0,6
f_{WL-pt}	0,3	-0,3	-0,3	0,3	-0,6	-0,4	-0,7	0,2
$f_{bilge-pt}$	0,3	-0,3	0,3	-0,3	-0,6	-0,4	-0,6	0,1
f_{ctr-pt}	1,0	-1,0	-0,6	0,6	-0,6	-0,6	-0,5	-0,5
f_{WL-stb}	0,3	-0,3	-0,3	0,3	-0,4	-0,6	0,2	-0,7
$f_{bilge-stb}$	0,3	-0,3	0,3	-0,3	-0,4	-0,6	0,1	-0,6
$f_{ctr-stb}$	1,0	-1,0	-0,6	0,6	-0,6	-0,6	-0,5	-0,5

Table 4.1.71 Dynamic load cases for strength assessment by FEM for a weather vaning of the unit length 300m and above under benign and moderate condition

Max response	M_{wv} (Sagging)	M_{wv} (Hogging)	Q_{wv} (Positive)	Q_{wv} (Negative)	a_v		M_{wv-h}	
Dynamic load case	1	2	3	4	5S	5P	6S	6P
f_{mv}	1,0	-1,0	1,0	-1,0	-0,6	-0,6	-0,7	-0,7
f_{qv}	-1,0	1,0	-1,0	1,0	0,7	-0,7	0,8	-0,8
f_{mh}	-0,85	0,85	-0,2	0,2	-0,7	0,7	1,0	-1,0
f_v	0,1	-0,1	-0,65	0,65	1,0	1,0	0,2	0,2
f_t	0,0	0,0	0,0	0,0	0,4	-0,4	0,1	-0,1
f_{lng}	-0,6	0,6	-1,0	1,0	-0,6	-0,6	-0,6	-0,6
f_{WL-pt}	-0,65	0,65	-0,2	0,2	-0,6	-0,3	-0,6	0,1
$f_{bilge-pt}$	-0,5	0,5	-0,4	0,4	-0,8	-0,2	-0,4	0,2
f_{ctr-pt}	1,0	-1,0	-0,2	0,2	-0,8	-0,8	-0,5	-0,5
f_{WL-stb}	-0,65	0,65	-0,2	0,2	-0,3	-0,6	0,1	-0,6
$f_{bilge-stb}$	-0,5	0,5	-0,4	0,4	-0,2	-0,8	0,2	-0,4
$f_{ctr-stb}$	1,0	-1,0	-0,2	0,2	-0,8	-0,8	-0,5	-0,5

Part 11, Chapter 1
General

■ *Section 1*
General

1.7 Information and plans

(Part only shown)

1.7.3 The following plans and particulars for Membrane tanks are to be submitted for approval before construction is commenced:

- o Details of on-site inspection to be carried out following an exceptional severe event (of similar magnitude of a 10 000 years return period event as per Pt 11, Ch 4, 2.1 Functional requirements 2.1.~~7~~5 (c)).

Part 11, Chapter 4
Cargo Containment

■ *Section 2*
Cargo containment

2.1 Functional requirements

(Part only shown)
2.1.5 The cargo containment system structural strength shall be assessed against failure modes, including but not limited to plastic deformation, buckling, and fatigue. The specific design conditions that should be considered for the design of each cargo containment system are given in *Pt 11, Ch 4, 6.1 Type A independent tanks* to *Pt 11, Ch 4, 6.5 Integral tanks*. ~~There are~~ The following three main categories of design conditions are to be assessed:

(c) **Accident design conditions** – The cargo containment system shall provide the indicated response to each of the following accident conditions (accidental or abnormal events), addressed in this Part:

- Loss of heading control – when applicable, the effect of loss of heading control on the cargo containment system shall be considered in the design as specified in *Pt 11, Ch 4, 3.5 Accidental loads*
- 10 000 year return period design condition – The cargo containment system integrity and its structural components shall withstand 10 000 year return period loads without loss of containment integrity, and without hydrocarbon release as specified by National Regulations, which could result in a major accident hazard for the unit. The design shall take into account proper combinations of the following loads:
    - Internal pressure.
    - External pressure.
    - Dynamic loads due to the motion of the ship unit.
    - Thermal loads.
    - Sloshing loads.
    - Loads corresponding to deflections of the ship unit.
    - Tank and cargo weight with the corresponding reaction in way of supports.
    - Insulation weight.
    - Loads in way of towers and other attachments.

  The associated safety factor for 10 000 year return period design condition is to be defined by the Owners/designers and is to comply with National Regulations. It shall be advised to LR at the commencement of the project.

Existing paragraph 2.1.7 has been deleted.

Existing paragraphs 2.1.8 and 2.1.9 have been renumbered 2.1.7 and 2.1.8.

2.6 Supporting arrangements

~~2.6.7 The effects on the supporting arrangements of the 10 000 year return period wave loading are to be considered as follows:~~
- ~~Resulting acceleration loadings.~~
- ~~Hull interaction loadings.~~

~~Calculations and analyses are to be performed to show that there would be no gross failure of the supporting arrangements in this event as prescribed above for each tank type.~~

■ *Section 3*
Design Loads

3.3 Functional loads

~~**3.3.10 10 000 year return period loading**~~
~~The effects on the containment system of the 10 000 year return period wave loading are to be considered.~~

Existing paragraph 3.3.11 has been renumbered 3.3.10.

■ *Section 4*
Structural Integrity

4.3 Design conditions

(Part only shown)
4.3.2 On-site operation design condition
Structural capacity may be determined by testing, or by analysis, taking into account both the elastic and plastic material properties, or by simplified linear elastic analysis.
(f) Stresses may be further limited by fatigue analysis, crack propagation analysis and buckling criteria.
~~The stresses resulting from the 10 000 year return period wave loading are not to exceed yield, or a higher stress level, provided permanent deformation can be permitted.~~

■ *Section 6*
Tank Types

6.1 Type A independent tanks

(Part only shown)

6.1.5 On-site operation design condition

(b) Tank boundary scantlings shall meet at least the requirements of LR for deep tanks taking into account the internal pressure as indicated in *Pt 11, Ch 4, 3.3 Functional loads 3.3.2* and any corrosion allowance required by *Pt 11, Ch 4, 2.1 Functional requirements 2.1.6* ~~and *Pt 11, Ch 4, 2.1 Functional requirements 2.1.7*~~.

Existing paragraph 6.1.6 has been deleted.

Existing paragraphs 6.1.7 and 6.1.8 have been renumbered 6.1.6 and 6.1.7.

6.2 Type B independent tanks

(Part only shown)

6.2.3 **On-site operation design condition**

(a) **Plastic deformation**

~~(iv) **10 000 year return period design condition**~~

~~The effects on the containment system of the 10 000 year return period wave loading are to be considered, as follows:~~

- ~~Dynamic cargo pressure loading.~~
- ~~Greatest sloshing pressures distribution.~~

~~Calculations and analyses are to be performed to show that there would be no gross failure of the cargo tanks, and no failure of the tank support system or pipe connections in this event.~~

6.3 Type C independent tanks

(Part only shown)

6.3.2 **Shell thickness**

(c) The thickness of pressure parts subject to internal pressure is to be in accordance with *Pt 5, Ch 11 Other Pressure Vessels* of the *Rules and Regulations for the Classification of Ships, July 2019* except that:

(iii) the constant thickness increment (0,75 mm) included in the formulae in ~~*Pt 5, Ch 11,2*~~ *Pt 5, Ch 11, 2 Cylindrical shells and drums subject to internal pressure* of ~~the*Rules and Regulations for the Classification of Ships, July 2019*~~ the *Rules and Regulations for the Classification of Ships, July 2019* may require to be increased in accordance with *Pt 11, Ch 4, 2.1 Functional requirements 2.1.6* ~~or *Pt 11, Ch 4, 2.1 Functional requirements 2.1.7*~~.

6.3.3 **On-site operation design condition**

~~(b) **10 000 year return period design condition**~~

~~The effects on the containment system of the 10 000 year return period wave loading are to be considered, as follows:~~

~~o Dynamic cargo pressure loading.~~

~~o Greatest sloshing pressures distribution.~~

~~Calculations and analyses are to be performed to show that there would be no gross failure of the cargo tanks, and no failure of the tank support system or pipe connections in this event.~~

Existing list item (c) has been renumbered (b).

6.4 Membrane tanks

6.4.3 **On-site operation design condition**

~~**(d) 10 000 year return period design condition**~~

~~The effects on the containment system of the 10 000 year return period wave loading are to be considered, as follows:~~

~~o Hull girder interaction loading.~~

~~o Greatest sloshing pressures distribution.~~

~~Calculations and analyses are to be performed to show that either the primary barrier or the secondary barrier should be expected to remain liquid tight and firmly fastened down in this event.~~

6.5 Integral tanks

6.5.2 **Structural analysis**

(a) On-site operation design condition

Integral tanks are to be designed and constructed in accordance with the requirements for cargo tanks in *Pt 10 Ship Units*, using the actual cargo density and additional vapour pressure.

~~**(b) 10 000 year return period design condition**~~

~~The effects of 10 000 year return period wave loading on the containment system are to be considered. This is to include:~~

~~o Hull girder loading.~~

~~o Dynamic cargo pressure loading.~~

~~o Greatest sloshing pressures distribution.~~

~~Calculations and analyses are to be performed to show that there would be no gross failure of the cargo tanks in this event.~~

Part 12, Chapter 1
Recognised Codes and Standards

■ *Section 1*
Abbreviations for recognised codes and standards

1.1 Abbreviations

1.1.1 The following abbreviations are used in this ~~Appendix~~ Chapter:

ACI American Concrete Institute
AFBMA Anti Friction Bearing Manufacturers Association
AISC American Institute of Steel Construction~~.~~
ALPEMA Aluminium Plate-Fin Heat Exchanger Manufacturer's Association
ANSI American National Standards Institute~~.~~
API American Petroleum Institute~~.~~
ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME American Society of Mechanical Engineers~~.~~
BCGA British Compressed Gases ~~Gas~~ Association~~.~~
BPVC ASME Boiler and Pressure Vessel Code
BS British Standard~~.~~
CAA~~.~~ United Kingdom Civil Aviation Authority~~.~~
CAP~~.~~ Civil Aviation Publication~~.~~
CIRIA Construction Industry Research and Information Association
CSA Canadian Standards Association~~.~~
DIN Deutsches Institut fur Normung~~.~~
EEMUA Engineering Equipment & Materials Users Association~~.~~
EI Energy Institute
EJMA Expansion Joint Manufacturers Association
EN~~.~~ European ~~Standard.~~Norm
FEM Federation Europeenne de la Manutention~~.~~
HSE The Health and Safety Executive
IACS International Association of Classification Societies~~.~~
ICAO The International Civil Aviation Organization
~~ISEA International Safety Equipment Association~~
IEC~~.~~ International Electrotechnical Commission~~.~~
IEEE Institute of Electrical and Electronics Engineers~~.~~
IMCA~~.~~ International Marine Contractors Association~~.~~
~~IP International Petroleum.~~
IOGP International Association of Oil and Gas Producers
ISEA International Safety Equipment Association
ISO International Standards Organisation~~.~~
ISSMGE International Society for Soil Mechanics and Geotechnical Engineering
LNG Liquefied natural gas
NACE National Association of Corrosion Engineers~~.~~
NFPA National Fire Protection Association~~.~~
NIPH Norwegian Institute of Public Health~~.~~
NS Norwegian Standard~~.~~
NSF National Science Foundation
OCIMF Oil Companies International Marine Forum
~~OGP International Association of Oil and Gas Producers.~~
PD Published Document
SGMF The Society for Gas as a Marine Fuel~~.~~
SMACNA Sheet Metal and Air Conditioning Contractors' National Association
SNAME Society of Naval Architects and Marine Engineers
TBK Norwegian Pressure Vessel Committee~~.~~
TEMA Tubular Exchanger Manufacturers Association
WRC Welding Research Council
~~UKOOA United Kingdom Offshore Operators Association.~~

■ *Section 3*
Bearings

3.1 Recognised codes and standards for bearings

3.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

ANSI/AFBMA Std 11 Load Ratings and Fatigue Life for Roller Bearings~~.~~
ASME paper 77-DE-39 Design Criteria to Prevent Core Crushing Failure in Large Diameter Case Hardened Ball and Roller Bearings~~.~~
~~BS 5512:1/~~BS ISO 281~~Dynamic Load Ratings and Rating Life of Rolling Bearings~~ Roller bearings. Dynamic load ratings and rating life~~.~~
~~BS 5645:/~~ BS ISO 76~~Static Load Ratings for Rolling Bearings~~ Roller bearings. Static load ratings~~.~~
~~ISO 281 Roller Bearing-Dynamic Load Ratings and Rating Life.~~
ISO 10438 (all parts) Petroleum and natural gas industries – Lubrication, shaft-sealing and control-oil systems and auxiliaries~~.~~

■ *Section 4*
Blow out prevention and well control

4.1 Recognised codes and standards for blow out prevention and well control

4.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API 6A Specification for Wellhead and Christmas Tree Equipment
API 7K Drilling and Well Servicing Equipment
~~API Spec. 16A Specification for Drill through Equipment.~~ API Spec 16A/ISO 13533 Drill-Through Equipment
API Spec 16C Choke and Kill Equipment.
API Spec~~.~~ 16D ~~Specification for~~ Control Systems for Drilling Well Control Equipment and Control Systems for Diverter Equipment~~.~~
API Spec~~.~~16F ~~Specification for~~ Marine Drilling Riser Equipment~~.~~
~~API Std 53 Blowout Prevention Equipment Systems for Drilling Operations.~~
~~API RP 16E Design of Control Systems for Drilling Well Control Equipment.~~
API RP 16Q Design, Selection, Operation and Maintenance of Marine Drilling Riser Systems
~~API Spec 16R Marine Drilling Riser Couplings~~
API Spec 16RCD Drill Rotating Control Devices
API RP 16ST Coiled Tubing Well Control Equipment Systems
API Std 6X Design Calculations for Pressure-containing Equipment
API Std 53 Well Control Equipment for Drilling Wells
API RP 59 Well Control Operations
API RP 64 Diverter Systems Equipment and Operations
IOGP S-562 Supplementary Requirements to API Specification 6D Ball Valves
~~API 6X Design Calculations for Pressure-containing Equipment~~

■ *Section 8*
Compressed gas utility systems

8.1 Recognised codes and standards for compressed gas utility systems

8.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

ANSI/ASME A13.1 Scheme for the Identification of Piping Systems
BCGA Guidance Note GN 2 Guidance for the storage of gas cylinders in the workplace~~.~~
BCGA Code of practice CP7 The safe use of oxy-fuel gas equipment (individual portable or mobile cylinder supply)~~.~~
BCGA Guidance Note GN 11 Reduced oxygen atmospheres~~.~~
BS EN 730-1 Gas welding equipment. Safety devices. Incorporating a flame (flashback) arrestor~~.~~
BS EN 1089-3 Transportable gas cylinders. Gas cylinder identification (excluding LPG). Colour coding~~.~~
BS EN ISO 7225 Gas cylinders. Precautionary labels~~.~~
BS EN ISO 7291 Gas welding equipment. Pressure regulators for manifold systems used in welding, cutting and allied processes up to 300 bar~~.~~
BS 1710 Specification for identification of pipelines and services~~.~~
NFPA 51 Standard for the Design and Installation of Oxygen - Fuel Gas Systems for Welding, Cutting, and Allied Processes~~.~~
NFPA 55 Compressed Gases and Cryogenic Fluids Code~~.~~
ISO 2503 Gas welding equipment -- Pressure regulators and pressure regulators with flow-metering devices for gas cylinders used in welding, cutting and allied processes up to 300 bar (30 MPa)~~.~~
ISO 9090 Gas tightness of equipment for gas welding and allied processes~~.~~
ISO 9539 Gas welding equipment -- Materials for equipment used in gas welding, cutting and allied processes~~.~~

ISO 14113 Gas welding equipment -- Rubber and plastics hose and hose assemblies for use with industrial gases up to 450 bar (45 MPa)~~.~~
ISO 14114 Gas welding equipment -- Acetylene manifold systems for welding, cutting and allied processes -- General requirements~~.~~
ISO 14726 Ships and marine technology -- Identification colours for the content of piping systems

■ *Section 9*
Concrete structures

9.1 Recognised codes and standards for concrete structures

9.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

ACI 357R-84 Guide for the Design and Construction of Fixed Offshore Concrete Structures
~~BS 8110 Structural Use of Concrete, Parts 1, 2 and 3.~~ BS EN 1992-1-1 Eurocode 2: Design of concrete structures: General rules and rules for buildings
CSA S471 General Requirements, Design Criteria, the Environment and Loads~~.~~
CSA S474 Concrete Structures, Offshore Structures~~.~~
ISO 19903 ~~Fixed Concrete Structures.~~ Petroleum and natural gas industries – Fixed concrete offshore structures
~~NS 3473~~ NS EN 1992-1-1 Eurocode 2 Concrete Structures – Design Rules~~.~~

Other publications:

- ~~Norwegian Petroleum Directorate, Guidelines relating to concrete structures to regulations relating to load bearing structures in the petroleum activities.~~ Petroleum Safety Authority Norway, Guidelines regarding the Facilities Regulations, Chapter X Load-Bearing Structure and Pipeline Systems

■ *Section 11*
Control and electrical systems

11.1 Recognised ~~c~~Codes and standards for control and electrical systems

11.1.1 The following Codes and ~~Standards~~ standards are recognised by LR:

CAP 437~~.~~ Standards for Offshore Helicopter Landing Areas~~.~~
IEC 60034 series, Rotating electrical machines~~.~~
IEC 60038 IEC standard voltages~~.~~
IEC 60076 series. Power transformers~~.~~
IEC 60079 series. Explosive atmospheres~~.~~
IEC 60085 Electrical insulation – Thermal evaluation and designation
IEC 60092-302~~.~~ Electrical installations in ships — Part 302: Low-voltage switchgear and controlgear assemblies~~.~~
IEC 60092-502~~.~~ Electrical installations in ships — Part 502: Tankers — Special features~~.~~
IEC 60092-503~~.~~ Electrical installations in ships — Part 503: Special features — AC supply systems with voltages in the range of above 1 kV up to and including 15 kV~~.~~
IEC 60092-504~~.~~ Electrical installations in ships ~~— Part 504: Special features — Control and instrumentation.~~ Part 504: Automation, control and instrumentation
IEC 60137~~.~~ Insulated bushings for alternating voltages above 1 000 V~~.~~
IEC 60146~~.~~ Semiconductor converters — General requirements and line commutated converters~~.~~
IEC 60204-32 Safety of ~~M~~machinery – Electrical equipment of machines: Part 32: requirements for hoisting machines~~.~~
IEC 60228 ~~Nominal cross-sectional areas~~ Conductors insulated cables~~.~~
IEC 60255 series. ~~Electrical Relays~~ Measuring relays and protection equipment~~.~~
IEC 60269 series. Low-voltage fuses~~.~~
IEC 60282 series. High-voltage fuses~~.~~
IEC 60300-3-11 Dependability management - Part 3-11: Application guide - Reliability ~~centered~~ centred maintenance~~.~~
IEC 60331 series~~,~~ Tests for electric cables under fire conditions, ~~fire resistant cables~~ circuit integrity~~.~~
IEC 60332 series~~,~~ Tests on electric and fibre optic cables under fire conditions,~~ flame retardant cables.~~
IEC 60445 Basic and safety principles for man-machine interface, marking and identification. Identification of equipment terminals, conductor terminations and conductors
IEC 60502~~.~~ Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV)~~.~~
IEC 60529 Degrees of ~~P~~protection ~~P~~provided by ~~E~~enclosures (IP Code)~~.~~
IEC 60533 Electrical and electronic installations in vessel – Electromagnetic ~~C~~compatibility (EMC) – Ships with a metallic hull~~.~~
IEC 60724~~.~~ Short-circuit temperature limits of electric cables with rated voltages of 1 kV (Um = 1,2 kV) and 3 kV (Um = 3,6 kV)~~.~~
IEC 60754 series~~,~~ Tests on gases evolved during combustion of materials from cables~~.~~
IEC 60757 Code for designation of colours~~.~~
IEC 60812 Analysis techniques for ~~S~~system ~~R~~reliability – Procedure for Failure Mode and Effects Analysis (FMEA)~~.~~
IEC 60839 series Alarm and ~~E~~electronic ~~S~~security ~~S~~systems~~.~~
IEC 60840~~.~~ Power cables with extruded insulation and their accessories for rated voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV) — Test methods and requirements~~.~~

IEC 60909 series~~,~~ Short-circuit currents in three-phase a.c. systems~~.~~
IEC 60947~~.~~ Low-voltage switchgear and controlgear~~.~~
IEC 60986~~.~~ Short-circuit temperature limits of electric cables with rated voltages from 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV)~~.~~
IEC 61000 series Electro~~-M~~magnetic ~~C~~compatibility (EMC)~~.~~
IEC 61078 ~~Analysis techniques for dependability – Reliability block diagram and Boolean methods.~~ Reliability block diagrams
IEC 61097 series~~,~~ Global maritime distress and safety system (GMDSS)~~.~~
IEC 61162 series~~,~~ Maritime navigation and radio communication equipment and systems – Digital interfaces~~.~~
IEC 61363-1 ~~Electrical installations of ships and mobile and fixed offshore units, calculating short-circuit currents.~~ Electrical installations of ships and mobile and fixed offshore units – Part 1: Procedures for calculating short-circuit currents in three-phase a.c
IEC 61439 series. Low-voltage switchgear and controlgear assemblies~~.~~
IEC 61443~~.~~ Short-circuit temperature limits of electric cables with rated voltages above 30 kV (Um = 36 kV)~~.~~
IEC 61508 series Functional ~~S~~safety of ~~E~~electrical/~~E~~electronic/~~P~~programmable ~~E~~electronic ~~S~~safety-related ~~S~~systems (E/E/PE~~,~~ or E/E/PES)~~.~~
~~IEC 61508. Functional safety of electrical/electronic/programmable electronic safety-related systems.~~
IEC 61511 series Functional ~~S~~safety - Safety instrumented systems for the process industry sector~~.~~
IEC 61557 series~~,~~ ~~Electrical safety in low voltage distribution systems up to 1000 Vac, Insulation monitoring devices.~~ Electrical safety in low voltage distribution systems up to 1000 Vac and 1500 Vdc – Equipment for testing, measuring or monitoring of protective measures
IEC 61892 series. Mobile and fixed offshore units — Electrical installations~~.~~
IEC 62040 series. Uninterruptible power systems (UPS)~~.~~
IEC 62271-100~~.~~ High-voltage switchgear and controlgear — Part 100: Alternating current circuit-breakers~~.~~
IEC 62271-102~~.~~ High-voltage switchgear and controlgear — Part 102: Alternating current disconnectors and earthing switches~~.~~
IEC 62271-104~~.~~ High-voltage switchgear and controlgear — Part 104: Alternating current switches for rated voltages of 52 kV and above~~.~~
IEC 62271-108~~.~~ High-voltage switchgear and controlgear — Part 108: High-voltage alternating current disconnecting ~~circuitbreakers~~ circuit breakers for rated voltages of 72,5 kV and above~~.~~
IEC 62271-200~~.~~ High-voltage switchgear and controlgear — Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV~~.~~
IEC 62271-201~~.~~ High-voltage switchgear and controlgear — Part 201: AC solid insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV~~.~~
IEC 62271-203~~.~~ High-voltage switchgear and controlgear — Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV~~.~~
IEC 62271-205~~.~~ High-voltage switchgear and controlgear — Part 205: Compact switchgear assemblies for rated voltages above 52 kV~~.~~
IEC 62305 series~~,~~ Protection against lightning~~.~~
IEC 62682 Management of ~~A~~alarm ~~S~~systems for the ~~P~~process ~~I~~industries~~.~~
IEEE Std 1584~~,~~ IEEE Guide for Performing Arc Flash Hazard Calculations~~.~~
IEEE Std 400.2~~.~~ IEEE Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF) (less than 1 Hz)~~.~~
IOGP S-620 Supplementary Specification to IEC 62271-200 High-voltage switchgear and controlgear
IOGP S-560 Supplementary Requirements to IEC 61439-1 & 2 Low-voltage switchgear and controlgear assemblies

■ *Section 12*
Corrosion protection

12.1 Recognised codes and standards for corrosion protection

12.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

BS EN 12473 General principles of cathodic protection in seawater
BS EN 13173 Cathodic protection for steel offshore floating structures~~.~~
ISO 1461 Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods
ISO 12944 series Paints and varnishes – Corrosion protection of steel structures by protective paint systems
ISO 19277 Petroleum, petrochemical and natural gas industries – Qualification testing and acceptance criteria for protective coating under insulation
ISO 20340 Paints and varnishes – Performance requirements for protective paint systems for offshore and related structures

■ *Section 13*
Cryogenic process equipment and LNG fuelling

13.1 Recognised codes and standards for cryogenic process equipment and LNG fuelling

(Part only shown)
13.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API MPMS Chapter 17.10.1/ISO 10976 Measurement of Cargoes On Board Marine Gas Carriers, Part 1: Liquefied Natural Gas

BS 6364 Specification for valves for cryogenic service – Appendix A applicable~~.~~
~~EEMUA 147 Recommendations for Liquefied Gas Storage Tanks.~~
BS EN 1160 Installations and equipment for liquefied natural gas. General characteristics of liquefied natural gas~~.~~
~~EN 12434 Cryogenic vessels – Cryogenic flexible hoses.~~
BS EN 1252-1 Cryogenic vessels – Materials ~~Part 1~~: Toughness requirements for temperatures below -80°C~~.~~
BS EN 1252-2 Cryogenic vessels – Materials ~~Part 2~~: Toughness requirements for temperatures between -80°C and -20°C~~.~~
BS EN 1473 Installation and equipment for liquefied natural gas. Design of onshore installations
BS EN 1474-1 Installation and equipment for liquefied natural gas. Design and testing of marine transfer systems. Design and testing of transfer arms
BS EN 1474-2 Installation and equipment for liquefied natural gas. Design and testing of marine transfer systems. Design and testing of transfer hoses
BS EN 1474-3 Installation and equipment for liquefied natural gas. Design and testing of marine transfer systems. Offshore transfer systems
BS EN 12434 Cryogenic vessels – Cryogenic flexible hoses
BS EN 13371 Cryogenic vessels – Couplings for cryogenic service~~.~~
BS EN 14197-1 Cryogenic vessels – Static non-vacuum insulated vessels ~~– Part 1~~: Fundamental requirements~~.~~
BS EN 14197-2 Cryogenic vessels – Static non-vacuum insulated vessels ~~– Part 2~~: Design, fabrication, inspection and testing~~.~~
BS EN 14197-3 Cryogenic vessels – Static non-vacuum insulated vessels ~~– Part 3~~: Operational ~~R~~requirements~~.~~
~~EN 1473 Installation and equipment for liquefied natural gas. Design of onshore installations.~~
~~EN 1474-1 Installation and equipment for liquefied natural gas. Design and testing of marine transfer systems. Design and testing of transfer arms.~~
~~EN 1474-2 Installation and equipment for liquefied natural gas. Design and testing of marine transfer systems. Design and testing of transfer hoses.~~
~~EN 1474-3 Installation and equipment for liquefied natural gas. Design and testing of marine transfer systems. Offshore transfer systems.~~
BS EN ISO 16904 Petroleum and natural gas industries - Design and testing of LNG marine transfer arm for on-shore applications
EEMUA 147 Recommendations for Liquefied Gas Storage Tanks
IACS Rec. No. 142 LNG ~~B~~bunkering ~~G~~guidelines~~.~~
IACS Rec. No. 146 Risk assessment as required by the IGF Code~~.~~
IACS Rec. No. 148 Survey of liquefied gas fuel containment systems
ISO 8143 Thermal insulation products for building equipment and industrial installations – Calcium silicate products
ISO 8943 Refrigerated light hydrocarbon fluids – Sampling of liquefied natural gas – Continuous and intermittent methods
ISO 10497 ~~Fire endurance testing for ESD valves.~~ Testing of valves – Fire type - testing requirements
ISO 10790 ~~Guidance to the selection, installation and use of Coriolis flow meters.~~ Measurements of fluid flow in closed conduits – Guidance to the selection, installation and use of Coriolis flowmeters (mass flow, density and volume flow measurements)
ISO 10976 ~~Measurement of cargoes on board LNG carriers.~~ Refrigerated light hydrocarbon fluids – Measurement of cargoes on board LNG carriers
ISO 16903 Petroleum and natural gas industries – Characteristics of LNG, influencing the design, and material selection
ISO 18132-1 ~~Tank gauges for LNG on board marine carriers and floating storage.~~ Refrigerated hydrocarbon and non-petroleum based liquefied gaseous fuels – General requirements for automatic tank gauges: Automatic tank gauges for liquefied natural gas on board marine carriers and floating storage
ISO 18132-2 ~~General requirements for automatic level gauges – refrigerated.~~ Refrigerated light hydrocarbon fluids – general requirements for automatic level gauges: Gauges in refrigerated-type shore tanks
ISO 20088 series Determination of the resistance to cryogenic spillage of insulation materials
ISO 20257-1 Installation and equipment for liquefied natural gas – Design of floating LNG installations: General requirements
ISO 20519 Ships and marine technology – Specification for bunkering of liquefied natural gas fuelled vessels~~.~~
ISO 21009-1 ~~Static vacuum insulated vessels~~ Cryogenic vessels – Static vacuum-insulated vessels: Design, fabrication, inspection and tests~~.~~
SGMF TGN06-04 Manifold arrangements for gas fuelled vessels

■ *Section 14*
Drilling equipment

14.1 Recognised codes and standards for drilling equipment

14.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API ~~4E~~ Spec. 4F Drilling and Well Servicing Structures~~.~~
API RP 7G Drill Stem Design and Operating Limits~~.~~
API Spec. 7-1/ISO 10424-1 Rotary Drill Stem Elements
API Spec. 7K Drilling and Well Servicing Equipment
API Spec. 8A – Drilling & Production Hoisting Equipment
API RP 8B ~~Hoisting Tool Inspection and Maintenance Procedures.~~ Procedures for Inspection, Maintenance, Repair and Remanufacture of Hoisting Equipment
API RP 9B Application, Care and Use of Wire Rope for Oil Field Service
~~API Spec. 7 Specification for Rotary Drilling Equipment.~~
API Spec. 8C Drilling and Production Hoisting Equipment (PSL 1 and PSL 2)~~.~~
API Spec. 9A Wire Rope~~.~~

API Spec. 11D1/ISO 14310 Packers and Bridge Plugs
API Spec. 16A/ISO 13533 Drill-Through Equipment
~~API RP 9B Application, Care and Use of Wire Rope for Oil Field Service.~~
ISO 10405 Petroleum and natural gas industries – Care and use of casing and tubing~~.~~
~~ISO 10407 Petroleum and natural gas industries – Drilling and production equipment – Drill stem design and operating limits.~~
ISO 10407-1 Petroleum and natural gas industries – Rotary drilling equipment – Part 1: Drill stem design and operating limits
ISO 10414 series Petroleum and natural gas industries – Field testing of drilling fluids
~~ISO 10426 Petroleum and natural gas industries – Cements and materials for well cementing.~~ ISO 10426-1 Petroleum and natural gas industries – Cements and materials for well cementing – Part 1: Specification
ISO 10427 series Petroleum and natural gas industries – Equipment for well cementing
ISO 11960 Petroleum and natural gas industries – ~~Steel pipes for use as casing or tubing for wells.~~ Steel drill pipe
ISO 11961 Petroleum and natural gas industries – Steel pipes for use as drill pipe – Specification~~.~~
ISO 13500 ~~Hydraulic fluid power – Determination of particulate contamination by automatic counting using the light extinction principle.~~ Petroleum and natural gas industries – Drilling fluid materials – Specifications and tests
~~ISO 13533 Petroleum and natural gas industries – Drilling and production equipment – Drill-through equipment.~~
~~ISO 14693 Petroleum and natural gas industries – Drilling and well-servicing equipment.~~
ISO 13624 series Petroleum and natural gas industries – Drilling and production equipment
ISO 13625 Petroleum and natural gas industries – Drilling and production equipment – Marine drilling riser couplings
ISO 13678 Petroleum and natural gas industries – Evaluation and testing of thread compounds for use with casing, tubing and line pipe and drill stem elements~~.~~
ISO 13680 Petroleum and natural gas industries – Corrosion-resistant alloy seamless tubes for use as casing, tubing and coupling stock – Technical delivery conditions~~.~~
ISO 14693 Petroleum and natural gas industries – Drilling and well-servicing equipment
ISO 15463 Petroleum and natural gas industries – Field inspection of new casing, tubing and plain-end drill pipe
ISO 17348 Petroleum and natural gas industries – Materials selection for high content CO_2 for casing, tubing and downhole equipment
~~FEM 1001 3rd Edition: Rules for the Design of Hoisting Appliances, Section 1, Booklets 3 to 8.~~ FEM Section 1 - Heavy Lifting and Handling Equipment. FEM 1.001 Rules for the Design of Hoisting Appliances, Booklets 1 to 8

■ *Section 15*
Dynamic positioning systems

15.1 Recognised codes and standards for dynamic positioning systems

15.1.1 The following ~~Standard~~ standards and codes ~~is~~ are recognised by LR:

API RP 2SK Design and Analysis of Stationkeeping Systems for Floating Structures
IMCA M 103 Guidelines for the design and operation of dynamically positioned vessels~~.~~
IMCA 245 IMO Guidelines for vessels and units with dynamic positioning (DP) systems
ISO 19901-7 Petroleum and natural gas industries – Specific requirements for offshore structures: Stationkeeping systems for floating offshore structures and mobile offshore units
ISO 19905-3 Petroleum and natural gas industries – Site-specific assessment of mobile offshore units: Floating unit

■ *Section 16*
Electrical welding systems

16.1 Recognised codes and standards for electrical welding systems

16.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

BS EN/IEC 60974-1 Arc welding equipment~~ – Part 1~~: Welding power sources~~.~~
BS EN/IEC 60974-7 Arc welding equipment~~ – Part 7~~: Torches~~.~~
BS EN/IEC 60974-9 Arc welding equipment~~ – Part 9~~: Installation and use~~.~~

■ *Section 17*
Ergonomics of control stations

17.1 Recognised codes and standards for ergonomics of control stations

17.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

ISO 8468 Ships and marine technology - Ship’s bridge layout and associated equipment – Requirements and guidelines~~.~~
ISO 11064 series Ergonomic design of control centres~~.~~
OGP Report 454 Human Factors Engineering in Projects

■ *Section 18*
Fire and safety standards

18.1 Recognised codes and standards for fire and safety standards

18.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API RP 2FB Design of Offshore Facilities Against Fire and Blast Loading
ISO 13702 Petroleum and natural gas industries – Control and mitigation of fires and explosions on offshore production installations – Requirements and guidelines~~.~~
ISO 15370 Ships and marine technology – Low location lighting (LLL) on passenger ships – Arrangement~~.~~
ISO 15544 Petroleum and natural gas industries – Offshore production installations – Requirements and guidelines for emergency response~~.~~
ISO 17631 Ships and marine technology – Shipboard plans for fire protection, life-saving appliances and means of escape~~.~~
ISO 24409-1 Ships and marine technology – ~~d~~Design, location and use of shipboard safety signs, safety notices and safety markings~~ - Part 1~~: Design principles~~.~~
NFPA ~~No.~~ 1 Fire ~~Prevention~~ Code~~.~~
NFPA ~~No.~~ 10 Portable Fire Extinguishers~~.~~
NFPA ~~No.~~ 11 ~~Low-Expansion Foam~~ Low-, Medium-, and High-Expansion Foam~~.~~
~~NFPA No. 11A Medium- and High-Expansion Foam Systems.~~
~~NFPA No. 11C Mobile Foam Apparatus.~~
NFPA ~~No.~~ 12 Carbon Dioxide Extinguishing Systems~~.~~
NFPA ~~No.~~ 12A Halon 1301 Systems~~.~~
NFPA ~~No.~~ 13 Sprinkler Systems~~.~~
~~NFPA No. 15 Water Spray Fixed Systems.~~
~~NFPA No. 14 Standpipe, Hose Systems.~~
NFPA 14 Standpipe, Hose Systems
NFPA 15 Water Spray Fixed Systems for Fire Protection
NFPA ~~No.~~ 16 ~~Deluge Foam-Water Systems~~ Installation of Foam-Water Sprinkler and Foam-Water Spray Systems~~.~~
~~NFPA No. 16A Closed Head Foam-Water Sprinkler Systems.~~
NFPA ~~No.~~ 17 Dry Chem. Ext. Systems~~.~~
NFPA ~~No.~~ 17A Wet Chem. Ext. Systems~~.~~
NFPA ~~No.~~ 20 ~~Centrifugal Fire Pumps~~ Installation of Stationary Pumps for Fire Protection~~.~~
NFPA ~~No.~~ 25 Water-based Fire Protection Systems~~.~~
NFPA 51 ~~Standard for the~~ Design and Installation of ~~Oxygen - Fuel~~ Oxygen–Fuel Gas Systems for Welding, Cutting, and Allied Processes~~.~~
NFPA 55 Compressed Gases and Cryogenic Fluids Code~~.~~
NFPA ~~No.~~ 68 ~~Venting of Deflagrations~~ Explosion Protection by Deflagration Venting~~.~~
NFPA ~~No.~~ 69 Explosion Prevention Systems.
NFPA ~~No.~~ 80 ~~Fire Doors and Fire Windows~~ Fire Doors and Other Opening Protectives~~.~~
NFPA ~~No.~~ 170 Fire Safety and Emergency Symbols~~.~~
NFPA ~~No.~~ 704 Fire Hazards of Materials~~.~~
NFPA ~~No.~~ 750 ~~Standard for Installation of Water Mist Fire Suppression System~~ Water Mist Fire Protection Systems~~.~~
NFPA 1901 Automotive Fire Apparatus
NFPA ~~No.~~ 2001 Clean Agent Fire Extinguishing~~.~~ Systems~~.~~
HSE OTI 95-634 Jet Fire Resistance Test of Passive Fire Materials~~.~~

■ *Section 19*
General structural items (skids, support frames and trusses etc.)

19.1 Recognised codes and standards for general structural items (skids, support frames and trusses etc.)

19.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

AISC LRFD Manual of Steel Construction – Load and Resistance Factor Design~~.~~
AISC Manual of Steel Construction – Allowable Stress Design~~.~~
~~API BUL 2U~~ API Bull 2V Design of Flat Plate Structures~~.~~
API RP 2A – WSD ~~Recommended Practice for~~ Planning, Design and Constructing Fixed Offshore Platforms Working Stress Design~~.~~
API RP 2FPS Planning, Designing, and Constructing Floating Production Systems
API RP 2T Planning, Designing, and Constructing Tension Leg Platforms
API RP 2SK ~~Recommended Practice for~~ Design and Analysis of Stationkeeping Systems for Floating Structures~~.~~
API Spec 4F Drilling and Well Servicing Structures
BS 2853 ~~The Design and Testing of Steel Overhead Runway Beams~~ Specification for the testing of steel overhead runway beams for hoist blocks~~.~~
~~BS 5400Steel, Concrete and Composite Bridges – Part 9: Bridge Bearing.~~
~~BS 5950 Structural Use of Steelwork in Building.~~
BS 5950-1 Structural use of steelwork in building. Code of practice for design. Rolled and welded sections
~~BS 6399-2 Loads for Buildings, Code of Practice for Wind Loads.~~

~~BS 8100 Lattice Towers and Masts.~~
~~BS 8118 Structural Use of Aluminium.~~
BS EN 1337-1 Structural. General design rules
BS EN 1337-2 Structural bearings. Sliding elements
BS EN 1337-3 Structural bearings. Elastomeric bearings
BS EN 1337-5 Structural bearings. Pot bearing
BS EN 1337-8 Structural bearings. Guide bearings and restrain bearings
BS EN 1337-9 Structural bearings. Protection
BS EN 1337-10 Structural bearings. Inspection and maintenance
BS EN 1337-11 Structural bearings. Transport, storage and installation
BS EN 1991 Eurocode 1: Actions on structures. General actions. Wind actions
BS EN 1993 Eurocode 3: Design of ~~S~~steel ~~S~~structures~~.~~
BS EN 1999 Eurocode 9: Design of aluminium structures. General structural rules
~~EN 1337 Structural bearings – Part 5: European Standard, Construction Standardisation: Pot Bearing.~~
~~EN 1337-10 Structural bearings – Part 10: Inspection and maintenance.~~
~~EN 1337-11 Structural bearings – Part 11: Transport, storage and installation.~~
~~EN 1337-1Structural bearings – Part 1: General design rules.~~
~~EN 1337-2Structural bearings – Part 2: Sliding elements.~~
~~EN 1337-3Structural bearings – Part 3: Elastomeric bearings.~~
~~EN 1337-8Structural bearings – Part 8: Guide bearings and restrain bearings.~~
~~EN 1337-9Structural bearings – Part 9: Protection.~~
BS EN 10204 Metallic products – Types of inspection documents
~~Euro-code 3 Design of steel structures – Part 2: Steel Bridge.~~

■ *Section 20*
Geotechnical

20.1 Recognised codes and standards for geotechnical and geophysical positioning

20.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API RP 2GEO/ISO 19901-4 Geotechnical and Foundation Design Considerations~~.~~
~~Geotechnical & Geophysical Investigations for Offshore and Nearshore Developments, International Society for Soil Mechanics and Geotechnical Engineering, 2005.~~
~~IMCA S 012, Guidelines on installation and maintenance of GNSS-based positioning systems, August 2009.~~
IMCA S 015 Guidelines for GNSS based positioning systems in the oil and gas industry~~, July 2011.~~
IMCA S 017~~,~~ Guidance on vessel USBL systems for use in offshore survey and positioning operations~~, April 2011.~~
IMCA S 024 Guidance on satellite-based positioning systems for offshore applications
ISO 13626 Petroleum and natural gas industries – Drilling and production equipment – Drilling and well-servicing structures.
ISO 19901-2~~,~~ Petroleum and natural gas industries – Specific requirements for offshore structures~~ – Part 2~~: Seismic design procedures and criteria~~.~~
ISO 19901-3 Petroleum and natural gas industries – Specific requirements for offshore structures: Topsides structure
ISO 19901-4~~,~~ Petroleum and natural gas industries – Specific requirements for offshore structures~~ – Part 4~~: Geotechnical and foundation design considerations~~.~~
ISO 19901-7~~,~~ Petroleum and natural gas industries – Specific requirements for offshore structures~~ – Part 7~~: Station keeping systems for floating offshore structures and mobile offshore units~~.~~
ISO 19901-8~~,~~ Petroleum and natural gas industries – Specific requirements for offshore structures~~ – Part 8~~: Marine Soil Investigations~~.~~
ISO 19901-9 Petroleum and natural gas industries – Specific requirements for offshore structures: Structural integrity management
ISSMGE Geotechnical & Geophysical Investigations for Offshore and Nearshore Developments, International Society for Soil Mechanics and Geotechnical Engineering, 2005

■ *Section 21*
Hazardous area classification

21.1 Recognised codes and standards for hazardous area classification

21.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API RP 500 Classification of Locations for Electrical Installations at Petroleum Facilities, Classified as Class 1, Division 1 and 2~~.~~
API RP 505 Classification of Locations for Electrical Installations at Petroleum Facilities, Classed as Class I, Zones 0, 1 ~~&~~ and 2~~.~~
~~EN 13463 series Non-electrical equipment for use in potentially explosive atmospheres.~~
BS EN 14986 Design of fans working in potentially explosive atmospheres~~.~~
BS EN ISO 80079-36 Explosive atmospheres. Non-electrical equipment for use in potentially explosive atmospheres. Basic method and requirements
EI Code, Part 15 Area Classification Code for Petroleum Installations
IEC 60079 series Explosive atmospheres~~.~~

IEC 60529 Degrees of protection provided by enclosures (IP Code)
~~EI Code, Part 15 Area Classification Code for Petroleum Installations.~~
ISO 17776 Petroleum and natural gas industries – Offshore production installations – ~~Guidelines on tools and techniques for hazard identification and risk assessment~~ Major accident hazard management during the design of new installations~~.~~
ISO 20321 Petroleum, petrochemical and natural gas industries – Safety of machineries – Powered elevators
~~NFPA 30 Flammable and Combustible Liquids Code.~~
ISO 22899-1 Determination of the resistance to jet fires of passive fire protection materials
ISO 20088-1 Cryogenic spillage
NFPA 30 Flammable and Combustible Liquids Code

■ *Section 22*
Helidecks

22.1 Recognised codes and standards for helidecks

22.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

CAP 437 Standards for Offshore Helicopter Landing Areas~~.~~
CAA Paper 2008/03 Helideck Design Considerations – Environmental Effects~~.~~
ICAO Annex 14 Aerodromes Volume II Heliports

■ *Section 23*
Lifting appliances

23.1 Recognised codes and standards for lifting appliances

23.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API Spec 2C ~~Specification for~~ Offshore Pedestal Mounted Cranes~~.~~
API RP 2D Operation and Maintenance of Offshore Cranes
API Spec 8C Drilling and Production Hoisting Equipment (PSL 1 and PSL 2)
API Spec 9A Wire Rope
API RP 9B Application, Care and Use of Wire Rope for Oil Field Service
ASME B30.20 Below the Hook Lifting Devices~~.~~
~~API Spec 8C Drilling and Production Hoisting Equipment (PSL 1 and PSL 2).~~
BS EN 10204 Metallic products – Types of inspection documents
BS EN 13586+A1 Cranes – Access~~.~~
BS EN 13852-1 Cranes - Offshore cranes ~~– Part 1:~~ General purpose offshore cranes~~.~~
BS EN 13852-2 Cranes - Offshore cranes ~~– Part 2:~~ Floating cranes~~.~~
~~FEM 1.001 Section-1: Heavy lifting appliances – Rules for the design of Hoisting Appliance Methods of Strength Calculation.~~
FEM Section 1 - Heavy Lifting and Handling Equipment. FEM 1.001 Rules for the Design of Hoisting Appliances, Booklets 1 to 8
IEC 60204-32 Safety of Machinery – Electrical Equipment of Machines – Part 32: Requirements for Hoisting Machines
IOGP S-617 Supplementary Specification to EN 13852-1 General-purpose offshore cranes
IOGP S-618 Supplementary Specification to API Specification 2C Offshore Pedestal-mounted Cranes
ISO 2374 Lifting ~~A~~appliances – Range of ~~M~~maximum ~~C~~capacities for ~~B~~basic ~~M~~models~~.~~
ISO 2408 Steel wire ropes – Requirements
ISO 3108 Steel wire ropes – Test method – Determination of measured breaking force
ISO 4309 Cranes - Wire ~~R~~ropes ~~-~~– Care and ~~M~~maintenance, ~~I~~inspection and ~~D~~discard~~.~~
ISO 8383 Lifts on ships - Specific requirements~~.~~
~~ISO 8566 Cranes - Cabins and control stations.~~ ISO 8566-1 Cranes – Cabins and control stations: General
ISO 10245 (all parts) Cranes – Limiting and indicating devices~~.~~
ISO 13534 Petroleum and natural gas industries – Drilling and production equipment – Inspection, maintenance, repair and remanufacture of hoisting equipment~~.~~
ISO 13535 Petroleum and natural gas industries – Drilling and production equipment – Hoisting equipment~~.~~
LR’s Code for Lifting Appliances in a Marine Environment~~.~~

■ *Section 24*
Materials for hydrogen sulphide and amine service

24.1 Recognised codes and standards for materials for hydrogen sulphide and amine service

24.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API RP 49 Drilling and Well Servicing Operations Involving Hydrogen Sulfide
API RP 941 Steels for Hydrogen Service at Elevated Temperatures
API RP 945 Avoiding Environmental Cracking in Amine Units

ISO 15156-1 Petroleum and natural gas industries – Materials for use in H2S~~-~~-containing environments in oil and gas production ~~– Part 1~~: General principles for selection of cracking-resistant materials~~.~~
ISO 15156-2 Petroleum and natural gas industries – Materials for use in H2S~~-~~--containing environments in oil and gas production ~~– Part 2~~: Cracking-resistant carbon and low alloy steels, and the use of cast irons~~.~~
ISO 15156-3 Petroleum and natural gas industries – Materials for use in H2S~~-~~--containing environments in oil and gas production ~~– Part 3~~: Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys~~.~~
NACE MR0175/ISO 15156 (all parts) Petroleum and ~~N~~natural gas industries materials for use in H2S~~-~~-containing environment in oil and gas production~~.~~

■ *Section 25*
Mooring and towing fittings

25.1 Recognised codes and standards for mooring and towing fittings

25.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

BS EN 10204 Metallic products – Types of inspection documents
ISO 13728 Ships and marine technology – Ship's mooring and towing fittings – Panama chocks~~.~~
ISO 13733 Ships and marine technology – Ship’s mooring and towing fittings – Universal fairleads with upper roller
ISO 13795 Ships and marine technology – Ship's mooring and towing fittings – Welded steel bollards for sea-going vessels~~.~~

■ *Section 26*
Mooring ~~winches and wires~~ systems

26.1 Recognised codes and standards for mooring ~~winches and wires~~ systems

26.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API Spec 2F Mooring Chain
API RP 2I In-Service Inspection of Mooring Hardware for Floating Structures
API RP 2SK Design and Analysis of Stationkeeping Systems for Floating Structures
API RP 2SM Design, Manufacture, Installation, and Maintenance of Synthetic Fiber Ropes for Offshore Mooring
BS 6349-2 Maritime works. Code of practice for the design of quay walls, jetties and dolphins
BS EN 10204 Metallic products – Types of inspection documents
ISO 3730 Ships and marine structures – Mooring winches~~.~~
ISO 2408 Steel wire ropes ~~for general purposes~~ – ~~Minimum~~ ~~requirements~~ Requirements.
ISO 19901-7 Petroleum and natural gas industries – Specific requirements for offshore structures: Stationkeeping systems for floating offshore structures and mobile offshore units
ISO 19905-3 Petroleum and natural gas industries – Site-specific assessment of mobile offshore units: Floating unit
OCIMF Mooring Equipment Guidelines (MEG4)

■ *Section 27*
Offshore containers

27.1 Recognised codes and standards for offshore containers

27.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

BS EN 12079-1~~:~~ Offshore containers and associated lifting sets. Design, manufacture and marking~~.~~
CAP 437 Standards for Offshore Helicopter Landing Areas~~.~~
International Maritime Dangerous Goods Code~~.~~
ISO 10855 series Offshore containers and associated lifting sets

■ *Section 28*
Piping systems and materials

28.1 Recognised codes and standards for piping systems and materials

28.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

~~ANSI/ASME B31.3 Process piping.~~
~~API Bul 2J Comparison of Marine Drilling Riser Analysis.~~
API Std 2RD Dynamic Risers for Floating Production Systems
API Spec 6D Pipeline and Piping Valves

API Spec 6FA Fire Test for Valves
API RP 14E Design and Installation of Offshore Production Platform Piping Systems~~.~~
API Spec 14L/ISO 16070 Lock Mandrels and Landing Nipples
API RP 15CLT Composite Lined Steel Tubular Goods
API Spec 15HR High Pressure Fiberglass Line Pipe
API Spec 15LE Polyethylene Line Pipe (PE)
API Spec 15LR Low Pressure Fiberglass Line Pipe
API Spec 15S Spoolable Reinforced Plastic Line Pipe
API Spec 16C Choke and Kill Equipment
API RP 16Q Design, Selection, and Operation and Maintenance of Marine Drilling Riser Systems
API RP 17B Flexible Pipe.
API Spec17J Unbonded Flexible Pipe
~~API RP 16C Specification for Choke and Kill Systems.~~
~~API RP 16Q Design, Selection, and Operation and Maintenance of Marine Drilling Riser Systems~~
~~API RP 16R Design Rating and Testing of Marine Drilling Riser Couplings.~~
~~API RP 17B Flexible Pipe.~~
~~API RP 17B Recommended Practice for Flexible Pipe.~~
~~API RP 2RD Riser Design.~~
~~API Spec 6D Pipeline Valves (Gate, Plug, Ball and Check Valves).~~
~~API Spec 6FA Fire Test for Valves.~~
~~API RP 535 Burners for fired heaters for general refinery services~~
~~API Spec.17J Specification for Unbonded Flexible Pipe.~~
~~API RP 2028 Flame arresters in piping systems~~
API Std 6AV2 Installation, Maintenance, and Repair of Surface Safety Valves and Underwater Safety Valves Offshore
API Std 526 Flanged Steel Pressure Relief Valves
API ~~STD~~ Std 527 Seat tightness of pressure relief valves~~.~~
API RP 535 Burners for Fired Heaters for General Refinery Services
API Std 570 Piping Inspection Code: In-Service Inspection, Rating, Repair and Alteration of Piping Systems
API Std 598 Valve Inspection and Testing
API Std 607 Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats
API RP 2028 Flame Arresters in Piping Systems
~~API STD 6AV2 Installation, Maintenance, and Repair of Surface Safety Valves and Underwater Safety Valves Offshore.~~
ANSI FC 70-2 Control valve leakage standard
ASME B16.47 Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard~~.~~
ASME B16.5 Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard~~.~~
ASME B31.1 Power Piping
ASME B31.3 Process Piping
ASME B31.4 Pipeline Transportation Systems for Liquids and Slurries
ASME B31.5 Refrigeration Piping and Heat Transfer Components
ASME B31.8 Gas Transmission and Distribution Piping Systems
~~ASME High Pressure System~~
ASME B40.100 Pressure Gauges and Gauge Attachments~~.~~
ASME PTC 19.3 TW: Thermowells Performance Test Codes
BS EN 10204 Metallic products – Types of inspection documents
BS EN 13480 Metallic industrial piping.
BS EN ISO 15714 series for Industrial valves - Actuators
EJMA – Standard of The Expansion joints manufacturer's association
~~BS 3351 Specification for Piping Systems for Petroleum Refineries and Petrochemical Plants.~~
~~BS PD 8010 Code of Practice for Pipelines, Part 3, Pipelines Subsea: Design, Construction and Installation.~~
~~ISO 10414 Petroleum and natural gas industries – Field testing of drilling fluids.~~
~~ISO 10426 Petroleum and natural gas industries – Cements and materials for well cementing.~~
~~ISO 10427 Petroleum and natural gas industries – Equipment for well cementing.~~
IOGP S-563 Material Data Sheets for Piping and Valve Components
IOGP S-611 Supplementary Requirements to API 600 Steel Gate Valves and to API 603 CRA Gate Valves
IOGP S-616 Supplementary Specification to API Specification 5L and ISO 3183 Line Pipe
ISO 3183 Petroleum and natural gas industries – Steel pipe for pipeline transportation systems
ISO 5208: Industrial valves - Pressure testing of metallic valves
ISO 8434-1 Metallic tube connections for fluid power and general use: 24 deg cone connectors
ISO 10434 Bolted bonnet steel gate valves for the petroleum, petrochemical and allied industries~~.~~
ISO 10497 Testing of valves — Fire type-testing requirements
ISO 11960 Petroleum and natural gas industries – Steel pipes for use as casing or tubing for wells~~.~~
ISO 13623 Petroleum and natural gas industries – Pipeline transportation systems~~.~~
ISO 13703 Petroleum and natural gas industries – Design and installation of piping systems on offshore production platforms~~.~~
ISO 13847 Petroleum and natural gas industries – Pipeline transportation systems – Welding of pipelines~~.~~
ISO 14313 Petroleum and natural gas industries – Pipeline transportation systems – Pipeline valves~~.~~
~~ISO 1461 Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods.~~
ISO 14692 series~~.~~ Petroleum and natural gas industries – Glass-reinforced ~~P~~plastics (GRP) ~~P~~piping~~.~~
ISO 14723 Petroleum and natural gas industries – Pipeline transportation systems-Subsea pipeline valves
ISO 14726 Ships and marine technology – Identification colours for the content of piping systems~~.~~
ISO 15156 series Petroleum and natural gas industries – Materials for use in ~~2~~ H_2S-containing environments in oil and gas production~~.~~

ISO 15463 Petroleum and natural gas industries – Field inspection of new casing, tubing and plain-end drill pipe~~.~~
ISO 15590 series Petroleum and natural gas industries – Induction bends, fittings and flanges for pipeline transportation systems~~.~~
ISO 15649 Petroleum and natural gas industries – Piping~~.~~
ISO 15761 Steel gate, globe and check valves for sizes DN 100 and smaller, for the petroleum and natural gas industries~~.~~
ISO 15848-1 Industrial valves - Measurement, test and qualification procedures for fugitive emissions
ISO 16852 Flame arrestor
~~ISO 16070 Petroleum and natural gas industries – Downhole equipment – Lock mandrels and landing nipples.~~
ISO 16440 Petroleum and natural gas industries – Pipeline transportation systems - Design, construction and maintenance of steel cased pipelines
ISO 17349 Petroleum and natural gas industries - Offshore platforms handling streams with high content of CO_2 at high pressures
~~ISO 18165 Petroleum and natural gas industries – Performance testing of cementing float equipment.~~
~~ISO 3183 Petroleum and natural gas industries – Steel pipe for pipeline transportation systems.~~
~~ISO 8434-1 Metallic tube connections for fluid power and general use – Part 1: 24 deg cone connectors.~~
ISO 21809 series Petroleum and natural gas industries – External coatings for buried or submerged pipelines used in pipeline transportation systems
NFPA 54/ANSI Z223.1. National Fuel Gas Code
~~PD 8010-2 Pipeline systems. Subsea pipelines. Code of practice~~
PD 8010 series Pipeline systems
~~UKOOA Specification and Recommended Practice for the Use of GRP Piping Offshore.~~

■ *Section 29*
Potable water and fresh water systems

29.1 Recognised codes and standards for potable water and fresh water systems

29.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

~~ANSI Z358.1 Emergency shower and eyewash equipment.~~ ANSI/ISEA Z358.1 Emergency eyewash and shower equipment
BS 2486 Recommendations for treatment of water for steam boilers and water heaters~~.~~
BS 6920-1 Suitability of non-metallic materials and products for use in contact with water intended for human consumption with regard to their effect on the quality of the water~~.~~
BS 7593 Code of practice for treatment of water in domestic hot water central heating systems ~~.~~
BS EN 1717 Protection against pollution of potable water installations and general requirements of devices to prevent pollution by backflow
BS EN 12953-10 Shell boilers. Requirements for feedwater and boiler water quality~~.~~
~~EN 1717 Protection against pollution of potable water installations and general requirements of devices to prevent pollution by backflow.~~
ISO 15748-1 Ships and marine technology – Potable water supply on ships and marine structures~~. Part 1~~: Planning and design~~.~~
ISO 15748-2 Ships and marine technology – Potable water supply on ships and marine structures~~. Part 2~~: Method of calculation~~.~~
NIPH Water Report 129 – Safe, Sufficient and Good Potable Water Offshore~~.~~
NSF/ANSI 60 - Drinking Water Treatment Chemicals – Health Effects~~.~~
NSF/ANSI 61 - Drinking Water System Components - Health Effects~~.~~
Seahealth Denmark - Drinking Water On Board Ships - A guidance about how to provide clean drinking water~~.~~
World Health Organisation - Guide to Ship Sanitation~~.~~
World Health Organisation - Guidelines for Drinking Water Quality.

■ *Section 30*
Pressure vessels/fired units/heat exchangers/storage tanks

30.1 Recognised codes and standards for pressure vessels/fired units/heat exchangers/storage tanks

30.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API Std 510 Pressure Vessel Inspection Code
API Std 530 Calculation of Heater Tube Thickness in Petroleum Refineries
API Std 620 Design and Construction of Large, Welded, Low-Pressure Storage Tanks
API Std 650 Welded Steel Tanks for Oil Storage
API Std 660 Shell and ~~t~~Tube ~~h~~Heat ~~e~~Exchangers for ~~g~~General ~~r~~Refinery ~~s~~Service~~.~~
API Std 661 Air Cooled Heat Exchangers for General Refinery Service~~.~~
~~API 662 Plate Heat Exchanger for General Refinery Services.~~
API Std 662, Part 1/ISO 15547-1 Plate Heat Exchangers for General Refinery Services – Plate-and-Frame Heat Exchangers
API Std 668 Brazed Aluminum Plate-Fin Heat Exchangers
~~API Std 662 Plate Heat Exchanger for General Refinery Services.~~
~~API RP 530 Calculation of Heater. Tube Thickness in Petroleum Refineries.~~
ASME BPVC Sec I Boiler And Pressure Vessel Code, Section I, Rules For The Construction Of Power Boilers~~.~~
~~ASME BPVC Sec IX Boiler And Pressure Vessel Code, Section Ix, Welding And Brazing Qualifications.~~

ASME Section IV into ASME BPVC Sec IV Boiler and Pressure Vessel Code, Section IV, Rules for Construction of Heating Boilers
~~ASME Section IV Heating Boilers~~
ASME BPVC Sec V Boiler And Pressure Vessel Code, Section V, Nondestructive Examination~~.~~
ASME BPVC Sec VIII-1 Boiler And Pressure Vessel Code, Section Viii, Rules For The Construction Of Pressure Vessels, Division 1~~.~~
ASME BPVC Sec VIII-2 Boiler And Pressure Vessel Code, Section Viii, Rules For The Construction Of Pressure Vessels, Division 2 – Alternative Rules~~.~~
ASME BPVC Sec VIII-3 Boiler And Pressure Vessel Code, Section Viii, Rules For The Construction Of Pressure Vessels, Division 3 – Alternative Rules For Construction Of High Pressure Vessels~~.~~
ASME BPVC Sec IX Boiler And Pressure Vessel Code, Section Ix, Welding And Brazing Qualifications
ASME BPVC Sec X Fiber-Reinforced Plastic Pressure Vessels
ASME 579-1 Fitness for Service
ASME RTP-1 Reinforced Thermoset Plastic Corrosion-Resistant Equipment
ALPEMA The Standards pf the Brazed Aluminium Plate-fin Heat Exchanger Manufacturers’ Association
~~ASME Section 1 Power Boilers.~~
~~ASME Section IV Heating Boilers.~~
BS 2790 ~~Shell Boiler of Welded Construction~~ Specification for design and manufacture of shell boilers of welded construction~~.~~
BS 799-5 Oil burning equipment: Carbon steel oil storage tanks – Specification
BS EN 1993-4-2 Eurocode 3-Design of steel structures - Tanks
BS EN 9809-1 & 2 Gas cylinders-Refillable seamless steel gas cylinders- Design, construction, testing
BS EN 11120 Gas cylinders - Refillable seamless steel tubes of water capacity between 150 l and 3000 l - Design, construction and testing
BS EN 12952 ~~Water-Tube Steam Generating Plant~~ Water-tube boilers and auxiliary installations
BS EN 12953 Shell boilers
BS EN 13121 series GRP tanks and vessels for use above ground
BS EN 13445 series Unfired pressure vessels
BS EN 13923 Filament wound FRP pressure vessels
BS EN 14015 Specification for the design and manufacture of site built, vertical, cylindrical, flat-bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperature and above
~~BS EN 1993-4-2 Eurocode 3-Design of steel structures - Tanks~~
EEMUA PUB No 143 Recommendations for Tube End Welding: Tubular Heat Transfer Equipment (Part 1 – Ferrous Materials)
IOGP S-613 Specification for Air Dryer Packages
IOGP S-614 Supplementary Specification to API Standard 660 Shell-and-Tube Heat Exchangers
IOGP S-619 Specification for Unfired, Fusion Welded Pressure Vessels
~~EEMUA PUB No 143 Recommendations for Tube End Welding: Tubular Heat Transfer Equipment (Part 1 – Ferrous Materials).~~
ISO 10961 Gas cylinders – Refillable seamless steel tubes of water capacity between 150 l and 3000 l – Design, construction and testing
ISO 13704 Petroleum, petrochemical and natural gas industries – Calculation of heatertube thickness in petroleum refineries~~.~~
ISO 13705 Petroleum, petrochemical and natural gas industries – Fired heaters for general refinery service~~.~~
ISO 13706 Petroleum, petrochemical and natural gas industries – Air-cooled heat exchangers~~.~~
ISO 15547 series Petroleum, petrochemical and natural gas industries – Plate-type heat exchangers~~.~~
ISO 16812 Petroleum, petrochemical and natural gas industries – Shell-and-tube heat exchangers~~.~~
~~ISO 16812 Petroleum, petrochemical and natural gas industries – Shell-and-tube heat exchangers.~~
ISO 18796-1 Petroleum, petrochemicals and natural gas industries – Internal coating and lining of carbon steel process vessels: Technical requirements
PD 5500 Unfired Fusion Welded Pressure Vessel~~.~~
TBK-1-2 General Rules for Pressure Vessels~~.~~
TEMA Standards of the Tubular Exchangers Manufacturers Association~~.~~
WRC Bull 107 Welding Research Council – Local Stresses in Spherical and Cylindrical Due to External Loading~~.~~
WRC Bull 297 Welding Research Council – Local Stresses in Spherical and Cylindrical Shells Due to External Loading on nozzles – Supplement to WRC Bull 107~~.~~

■ *Section 31*
Process plant rotary equipment

31.1 Recognised ~~c~~Codes and standards for process plant rotary equipment

31.1.1 The following Codes and ~~Standards~~ standards are recognised by LR:

~~API 610 Centrifugal Pumps for General Refinery Service.~~ API Std 610/ISO 13709 Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
API Std 611 General Purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Services
~~API 615 Sound Control of Mechanical Equipment for Refinery Service.~~ API RP 615 Valve Selection Guide
~~API 616 Combustion Gas Turbines for General Refinery Service.~~
~~API 617 Centrifugal Compressors for General Refinery Services.~~
~~API RP 550 Recommended Practice: Manual on Installation of Refinery Instruments and Control Systems, Parts 1 to 4.~~
API Std 613 Special Purpose Gear Units for Petroleum, Chemical, and Gas Industry Services~~.~~

~~API Std 614 Lubrication, Shaft-Sealing, and Control-Oil Systems and Auxiliaries for Petroleum, Chemical and Gas Industry Services.~~ API Std 614/ISO 10438-1 Lubrication, Shaft-Sealing and Oil Control Systems and Auxiliaries
API Std 616 Gas Turbines for the Petroleum, Chemical and Gas Industry Services
API Std 617 Axial and Centrifugal Compressors and Expander-Compressors
API Std 618 Reciprocating Compressors for Petroleum, Chemical, and Gas Industry Services~~.~~
~~API Std 619 Rotary Type Positive Displacement Compressors for Petroleum, Chemical, and Gas Industry Services.~~ API Std 619/ISO 10440-1 Rotary-Type Positive Displacement Compressors for Petroleum, Petrochemical and Natural Gas Industries
API Std 620 Design and Construction of ~~l~~Large, ~~w~~Welded, ~~l~~Low-~~p~~Pressure ~~s~~Storage ~~t~~Tanks~~.~~
API Std 650 Welded ~~s~~Steel ~~t~~Tanks for ~~o~~Oil ~~s~~Storage~~.~~
API Std 670 Machinery Protection Systems~~.~~
~~API Std 671~~ API Std 671/ISO 10441 Special ~~p~~Purpose Couplings for Petroleum, Chemical and Gas Industry Services~~.~~
API Std 672 Packaged, ~~i~~Integrally ~~g~~Geared, ~~c~~Centrifugal ~~a~~Air ~~c~~Compressors for ~~p~~Petroleum, ~~c~~Chemical and ~~g~~Gas ~~i~~Industry ~~s~~Services~~.~~
API Std 673 Centrifugal Fans for Petroleum, Chemical and Gas Industry Service~~.~~
API Std 674 Positive ~~d~~Displacement ~~p~~Pumps – Reciprocating~~.~~
API Std 675 Positive ~~d~~Displacement ~~p~~Pumps – Controlled ~~v~~Volume~~.~~
API Std 676 Positive ~~d~~Displacement ~~p~~Pumps – Rotary~~.~~
API Std 681 Liquid Ring Vacuum Pumps and Compressors for Petroleum, Chemical, and Gas Industry Services~~.~~
API Std 682 Shaft Sealing Systems for Centrifugal and Rotary Pumps~~.~~
ASME B73.1 Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process~~.~~
ASME B73.2~~M~~ Specification for Vertical In-Line Centrifugal Pumps for Chemical Process~~.~~
EEMUA PUB No 141 Guide to the use of EEMUA 140 Noise Procedure Specification~~.~~
IOGP S-612 Supplementary Specification to API Standard 672 Packaged, Integrally Geared Centrifugal Air Compressors
IOGP S-615 Supplementary Specification to ANSI/API Standard 610 Centrifugal Pumps
ISO 2314 Gas turbine acceptance tests
ISO 2858 End-suction centrifugal pumps (rating 16 bar) – Designation, nominal duty point and dimensions
ISO 2954 Mechanical vibration of rotating and reciprocating machinery – Requirements for instruments for measuring vibration severity
ISO 3046 (all parts) Reciprocating internal combustion engines – Performance
ISO 3977 (all parts) Gas turbines – Procurement
ISO 5199 Technical specifications for centrifugal pumps - Class II
ISO 9906 Roto-dynamic pumps – Hydraulic performance acceptance tests – Grades 1, 2 and 3
ISO 10431 Petroleum and ~~N~~natural ~~G~~gas ~~I~~industries – Pumping ~~U~~units – Specification~~.~~
~~ISO 10436 Petroleum and Natural Gas Industries – General purpose steam turbines for refinery service.~~
ISO 10437 Petroleum, petrochemical and natural gas industries – Steam turbines – Special-purpose applications~~.~~
ISO 10438 series Petroleum, petrochemical and natural gas industries – Lubrication, shaft-sealing and control-oil systems and auxiliaries~~.~~
ISO 10439 series Petroleum, chemical and gas service industries – Centrifugal compressors~~.~~
ISO 10440 (all parts) Petroleum and ~~N~~natural ~~G~~gas ~~I~~industries – Positive displacement-rotary type compressors~~.~~
ISO 10441 Petroleum, petrochemical and natural gas industries – Flexible couplings for mechanical power transmission – Special-purpose applications~~.~~
ISO 13631 Petroleum and natural gas industries – ~~Packaged reciprocating gas compressors~~ Rotary-type positive-displacement compressors~~.~~
ISO 13691 Petroleum and natural gas industries – High-speed special-purpose gear units~~.~~
ISO 13707 Petroleum and natural gas industries – Reciprocating compressors~~.~~
ISO 13709 Centrifugal pumps for petroleum, petrochemical and natural gas industries
ISO 13710 Petroleum, petrochemical and natural gas industries – Reciprocating positive displacement pumps
~~ISO 14310 Petroleum and natural gas industries – Downhole equipment – Packers and bridge plugs.~~
ISO 14691 Petroleum and natural gas industries – Flexible couplings for mechanical power transmission – General purpose applications~~.~~
ISO 15136 ~~Downhole equipment for petroleum~~ series Petroleum and natural gas industries – Progressing cavity pump systems for artificial lift.
~~ISO 2314 Gas Turbine Acceptance Tests.~~
~~ISO 2858 End-suction centrifugal pumps (rating 16 bar) – Designation, nominal duty point and dimensions.~~
~~ISO 2954 Mechanical vibration of rotating and reciprocating machinery – Requirements for instruments for measuring vibration severity.~~
~~ISO 3046 (all parts) Reciprocating internal combustion engines – Performance.~~
~~ISO 3977 (all parts) Gas turbines – Procurement. ISO 5199 Technical specs. for centrifugal pumps- Class II.~~
~~ISO 9906 Roto-dynamic pumps – Hydraulic performance acceptance tests – Grades 1 and 2.~~
NFPA ~~No.~~ 37 Stationary Combustion Engines and Gas Turbines~~.~~

- *Section 32*
  Process safety

32.1 Recognised codes and standards for process safety

32.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API RP 14C Analysis, Design, Installation, and Testing of Safety Systems for Offshore Production Facilities

API RP 14J Design and Hazards Analysis for Offshore Production Facilities
API RP 17O Subsea High Integrity Pressure Protection Systems (HIPPS)
API ~~STD~~ Std 520 Sizing, Selection, and Installation of Pressure-relieving Devices Part I & Part II~~.~~
API ~~STD~~ Std 521 Pressure Relieving and Depressurising Systems~~.~~
API ~~STD~~ Std 537 Flare Details for General Refinery and Petrochemical Service~~.~~
API ~~STD~~ Std 2000 Venting Atmospheric and Low-Pressure Storage Tanks~~.~~
~~API RP 14C Recommended Practices for Analysis, Design, Installation and Testing of Basic Surface Safety Systems on Offshore Production Platforms.~~
~~API RP 14J Recommended Practice for Design and Hazards Analysis for Offshore Production Facilities.~~
~~API RP 17O Recommended Practice for Subsea High Integrity Pressure Protection Systems (HIPPS).~~
ISO 10418 Petroleum and natural gas industries - Offshore production installations - Analysis, design, installation and testing of basic ~~Basic~~ surface process safety systems~~.~~
~~ISO 23251 Petroleum, petrochemical and natural gas industries - Pressure-relieving and depressuring systems.~~
ISO 25457 Petroleum, petrochemical and natural gas industries - Flare details for general refinery and petrochemical services~~.~~
ISO 28300 Petroleum, petrochemical and natural gas industries - Venting of atmospheric and low pressure storage tanks~~.~~
ISO/IEC 31010 Risk management – Risk assessment techniques

■ *Section 33*
Reliability-centred maintenance

33.1 Recognised codes and standards for reliability centred maintenance

33.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

~~NACE MR0175/ISO 15156 Petroleum and Natural gas industries materials for use in 2 H2S-containing environment in oil and gas production.~~
~~ISO 19901-4 Petroleum and natural gas industries – Specific requirements for offshore structures – Part 4: Geotechnical and foundation design considerations.~~
~~ISO 15156-1 Petroleum and natural gas industries – Materials for use in 2 -containing environments in oil and gas production – Part 1: General principles for selection of cracking-resistant materials.~~
~~ISO 15156-2 Petroleum and natural gas industries – Materials for use in 2 -containing environments in oil and gas production – Part 2: Cracking-resistant carbon and low alloy steels, and the use of cast irons.~~
~~ISO 15156-3 Petroleum and natural gas industries – Materials for use in 2 -containing environments in oil and gas production – Part 3: Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys.~~
API RP 17N Subsea Production System Reliability and Technical Risk Management
BS EN ISO 20815 Petroleum and natural gas industries – Production assurance and reliability management
IEC 60300–3-11 Dependability management – Part 3-11: Application guide – Reliability centred maintenance
IEC 61078 Reliability block diagrams
ISO 14224 Petroleum, petrochemical and natural gas industries – Collection and exchange of reliability and maintenance data for equipment~~.~~
ISO/TR 12489 Petroleum, petrochemical and natural gas industries – Reliability modelling and calculation of safety systems

■ *Section 34*
Safety of machinery

34.1 Recognised codes and standards for safety of machinery

34.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

ISO 12100 ~~*Safety of machinery - General principles for design - Risk assessment and risk reduction.*~~ Safety of machinery - General principles for design - Risk assessment and risk reduction
ISO 13849 series Safety of machinery – Safety-related parts of control systems
ISO 13850 ~~*Safety of machinery - Emergency stop - Principles for design.*~~ Safety of machinery - Emergency stop - Principles for design
ISO 14122 series ~~*- Safety of Machinery - Permanent Means of Access to Machinery.*~~ Safety of machinery - Permanent means of access to machinery
ISO 21789 Gas turbine applications – Safety~~.~~

■ *Section 35*
Safety signage

35.1 Recognised codes and standards for safety signage

35.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

BS EN ISO 7010 Graphical symbols. Safety colours and safety signs. Registered safety signs~~.~~

BS ISO 24409-1 Ships and marine technology – ~~d~~Design, location and use of shipboard safety signs, safety-related signs, safety notices and safety markings~~ – Part 1~~: Design principles~~.~~
BS EN 82079-1 Preparation of instructions for use. Structuring, content and presentation. General principles and detailed requirements

■ *Section 36*
Subsea production systems

36.1 Recognised codes and standards for subsea Production Systems

36.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API Std 6AV2 Installation, Maintenance and Repair of Surface Safety Valves and Underwater Safety Valves Offshore
API RP 17A/ISO 13628-1 Design and Operation of Subsea Production Systems-General Requirements and Recommendations
API RP 17B Flexible Pipe
API Spec 17D/ISO 13628-4 Design and Operation of Subsea Production Systems-Subsea Wellhead and Tree Equipment
API Spec 17E/ISO 13628-5 Subsea Umbilicals
API Spec 17F Subsea Production Control Systems
API RP 17G/ISO 13628-7 Completion/Workover Riser Systems
API RP 17H Remotely Operated Tools and Interfaces on Subsea Production Systems
API Spec 17L1 – Specification for Flexible Pipe Ancillary Equipment
API RP 17L2 Flexible Pipe Ancillary Equipment
API Spec 17J Unbonded Flexible Pipe
API RP 17K/ISO 13628-10 Bonded Flexible Pipe
API RP 17N Subsea Production System Reliability and Technical Risk Management
API RP 17O Subsea High Integrity Pressure Protection Systems (HIPPS)
API RP 17P/ISO 13628-15 Subsea Structures and Manifolds
API RP 17R Flowline Connectors and Jumpers
API RP 17U Wet and Dry Thermal Insulation of Subsea Flowlines and Equipment
API RP 17V Analysis, Design, Installation, and Testing of Safety Systems for Subsea Applications
API RP 17W Subsea Capping Stacks
~~ISO 14723 Petroleum and natural gas industries – Pipeline transportation systems – Subsea pipeline valves.~~
IOGP 561 Supplementary Specification to API 17D Subsea Trees
ISO 13628-1 Petroleum and natural gas industries – Design and operation of subsea production systems~~ – Part 1~~: General requirements and recommendations~~.~~
ISO 13628-2 Petroleum and natural gas industries – Design and operation of subsea production systems~~ – Part 2~~: Unbonded flexible pipe systems for subsea and marine applications~~.~~
ISO 13628-3 Petroleum and natural gas industries – Design and operation of subsea production systems~~ – Part 3~~: Through flowline (TFL) systems~~.~~
ISO 13628-4 Petroleum and natural gas industries – Design and operation of subsea production systems~~ – Part 4~~: Subsea wellhead and tree equipment~~.~~
ISO 13628-5 Petroleum and natural gas industries – Design and operation of subsea production systems~~ – Part 5~~: Subsea umbilicals~~.~~
ISO 13628-6 Petroleum and natural gas industries – Design and operation of subsea production systems~~ – Part 6~~: Subsea production control systems~~.~~
ISO 13628-8 Petroleum and natural gas industries – Design and operation of subsea production systems: Remotely operated vehicle (ROV) interfaces on subsea production systems
ISO 13628-9 Petroleum and natural gas industries – Design and operation of subsea production systems~~ – Part 9~~: Remotely ~~O~~operated ~~T~~tool (ROT) intervention systems~~.~~
ISO 13628-11 Petroleum and natural gas industries – Design and operation of subsea production systems: Flexible pipe systems for subsea and marine applications
ISO 14723 Petroleum and natural gas industries – Pipeline transportation systems – Subsea pipeline valves
ISO 19345-2 Petroleum and natural gas industry – Pipeline transportation systems – Pipeline integrity management specification – Part 2: Full-life cycle integrity
PD 8010-2 Pipeline systems. Subsea pipelines. Code of practice

■ *Section 37*
Ventilation

37.1 Recognised codes and standards for ventilation

37.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

ASHRAE Handbook HVAC Applications~~.~~
ASHRAE Handbook HVAC Systems and Equipment~~.~~
~~ASHRAE/ANSI STD 62~~ ANSI/ASHRAE Std 62.1 Ventilation for Acceptable Indoor Air Quality~~.~~
Note production units only:

ISO 7547 Ships and marine technology – Air conditioning and ventilation of accommodation spaces - Design conditions and basis of calculation
ISO 8861 Ships and marine technology – Engine room ventilation in diesel engine ships – Design conditions and basis of calculation
ISO 9943 Shipbuilding – Ventilation and air-treatment of galleys and pantries with cooking appliances
ISO 15138 Petroleum and natural gas industries - ~~o~~Offshore production installations ~~-~~– ~~h~~Heating, ventilation and air-conditioning.
~~ISO 7547 Ships and marine technology – Air conditioning and ventilation of accommodation spaces - Design conditions and basis of calculation.~~
~~ISO 8861 Ships and marine technology – Engine room ventilation in diesel engine ships – Design conditions and basis of calculation.~~
~~ISO 9943 Shipbuilding – Ventilation and air-treatment of galleys and pantries with cooking appliances.~~
NFPA 90A ~~Standard for the~~ Installation of Air-Conditioning and Ventilation Systems~~.~~
NFPA 96 ~~Standard for~~ Ventilation Control and Fire Protection of Commercial Cooking Operations~~.~~
~~Note production units only:~~
SMACNA HVAC Duct Construction Standards~~.~~
SMACNA HVAC Systems Duct Design~~.~~

■ *Section 38*
Wave contour development

38.1 Recognised codes and standards for wave contour development

38.1.1 The following ~~Standard~~ codes and standards ~~is~~ are recognised by LR:

Environmental Parameters for Extreme Response: Inverse ~~Form~~ FORM with Omission Factors, Winterstein et al, ISBN No. 9054103571~~.~~
ISO 19901-1 Petroleum and natural gas industries – Specific requirements for offshore structures – Part 1: Metocean design and operating considerations
SNAME Transactions 2009, Environmental Contour Lines: A Method for Estimating Long Term Extremes by a Short Term Analysis, Haver S. & Winterstein S.R

■ *Section 39*
Wellhead equipment

39.1 Recognised codes and standards for wellhead equipment

39.1.1 The following ~~Codes~~ codes and ~~Standards~~ standards are recognised by LR:

API Spec~~.~~ 6A & ISO 10423 Wellhead and Christmas Tree: Equipment~~.~~
API Std 6X Design Calculations for Pressure-containing Equipment
~~API Spec. 14D Wellhead Surface Safety Valves and Underwater Safety Valves for Offshore Service.~~
API Spec 14A Subsurface Safety Valve Equipment
~~API RP 14B Design, Installation and Operation of Subsurface Safety Valve Systems.~~ API RP 14B/ISO 10417 Design, Installation, Operation, Test, and Redress of Subsurface Safety Valve Systems
~~API RP 17D Specification for Subsea Wellhead and Christmas Tree Equipment.~~ API Spec 17D/ISO 13628-4 Design and Operation of Subsea Production Systems-Subsea Wellhead and Tree Equipment
ISO 13628-4 Petroleum and natural gas industries – Design and operation of subsea production systems – Part 4: Subsea wellhead and tree equipment

■ *Section 40*
Wind gust spectra formulations

40.1 Recognised codes and standards for wind gust spectra formulations

40.1.1 The following ~~Standard~~ codes and standards ~~is~~ are recognised by LR:

~~API RP 2A Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms.~~ API RP 2FPS Planning, Designing, and Constructing Floating Production Systems
Other publications:
~~Deaves D.M & Harris R.I 1978 A mathematical model of the structure of strong winds, CIRIA Report No. 76.~~ CIRIA report No. 76, Deaves D.M. & Harris R.I., 1978, A mathematical model of the structure of strong winds, ISBN 9780860170860
~~Slettringen (Norwegian Petroleum Directorate).~~ ASME Journal of Offshore Mechanics and Arctic Engineering 2003, Extreme response of floating structures in combined wind and waves, Teigen P. & Naess A
ISO 19901-1 Petroleum and natural gas industries – Specific requirements for offshore structures – Part 1: Metocean design and operating considerations

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